PB81-151045

Fate and Effect of Oil in the Aquatic Environment - Gulf Coast Region

Mississippi State Univ.
Mississippi State

Prepared for

Environmental Research Lab.
Narragensett, RI

Jul 80

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16. ABSTRACT

The purpose of this research investigation was to determine the fate and effect of crude oil in the aquatic environment of the coastal Gulf of Mexico. The project was multi-disciplinary and multi-institutional in scope and involved both laboratory and field sized pilot-plant ecosystem studies. Emphasis was placed on the long-term, low-level chronic effects of oil pollution on the ecosystem. Of the five crudes employed in the investigation, Empire Mix crude was studied most intensively.

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a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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FATE AND EFFECT OF OIL IN THE AQUATIC ENVIRONMENT - GULF COAST REGION

APPENDIX

by

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APPENDIX

Item 1

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CRUDE NAME Empire Mix Crude
ORIGIN Crude 2 Test Run 2-17-72

CRUDE OIL EVALUATION
STANDARD OIL COMPANY (KY)
PASCAGOULA REFINERY

LAB & REPORT NO. 947
DATE July 28,1972

	Crude as Received	Light Ends	Light St. Run Gaso.	Heavy St. Run Gaso.	Heavy Heavy St. Run	Jet A/ Kerosene	Salable Gas Oils		Non-Sal. Gas Oils		Residuum
							Light	Heavy	Light	Heavy	
Vapor Line Temp., TBP, °F		C_1-C_4	C_5-215	215-355	355-400	355-495	495-535	495-600	600-790	790-1050	1050+
Yield From Crude LV%		1.30	4.41	10.43	3.93	15.61	6.24	14.84	20.78	19.69	12.94
Yield Range From Crude, LV%		0.00-	1.30-	5.71-	16.14-	16.14-	31.75-	31.75-	46.59-	67.37-	87.06-
		1.30	5.71	16.14	20.07	31.75	37.99	46.59	67.39	87.06	100.00
Gravity, °API	31.0		69.2	51.0	43.6	39.4	24.7	34.1	28.2	22.2	13.2
Vis. @-30° CS				2.43		13.10	frozen				
Vis. @ 100° CS				0.78 cs.	1.24 cs.	1.71 cs.	3.04 cs.	3.96 cs.			
Vis. @ 100° SSU	52.9					NC	36.1	39.1	75.1		
Vis. @ 130° SSU								35.1	53.0		
Vis. @ 210° SSF											
Sulfur, Wt. %	.338		.001			.038		.096	.267		
Freeze Pt., ASTM D2386, °F			-121	-108	-87	-56		-6			
Smoke Pt., ASTM D1322, MM			46	28		22		15			
RVP, ASTM D-323, PSI	2.6		6.8	.7							
F-1+.5 ML TEL/gal			ISS	58.3	44.0						
F-1+3 ML TEL/gal			89.7	75.3	ISS						
F-2+3 ML TEL/gal			ISS	ISS	ISS						
Cetane Index, ASTM D-975						42.4	46.8	51.6	53.8		
Pour Pt., ASTM D-97, °F	+5					-65		-15	+40		
Total Nitrogen, PPM								63	206		
Characterization Factor, UOPK								11.78	11.83		
Vol. Avg. Boiling Pt., °F								545	663		
Aniline, ASTM D1012, °F				HYDROCARBON TYPES LV%				141.4	178.2		
BS&W, %	0.2			P 42.39	36.03						
Hydrogen Sulfide			<1	DN 2.01	0.91	<1		<1	METALS PPM		
Mercaptan Sulfur			<1	N 47.05	55.62	3		4	Ni 0.001		
Aromatics %				A 8.55	7.44	11.9	21.7		V 0.01		
Olefins %				N*		2.2	0.7		Cu		
Saturates %						85.9	77.6				
ASTM Distillation, Method	D86	GALIPA	D86	D86	D86	D86	D86	D86	D1160*	D1160*	
Start (5% on D-1160)	158/262	(% of crude)	118/142	250/258	356/364	370/396	496/498	515/529	634	786	
10	324/422	$C1^-$ 0.00	146/152	266/270	366/368	400/404	498/500	531/534	636/641	797/817	
30	500/542	$C2^=$ 0.11	160/166	276/280	368/370	410/414	500/502	537/539	643/649	837/860	
50	560	$C3^=$ 0.28	176/182	286/294	372/374	420/426	502/504	543/547	653/665	874/905	
70	-	$iC_4^=$ 0.25	188/196	302/310	376/378	434/440	506/510	550/557	671/687	926/955	
90		$nC_4^=$ 0.66	204/210	324/332	384/388	448/458	512/514	565/570	711/735	985/1002	
EP	560	Tot.C_4 1.30	220	340	394	464	528	582	753	1012	
% Rec.	45.0	IC_5 0.62	99.0	99	99	98	99	99	97.5	97.0	
% Rec.	55.0	NC_5 0.83	1.0	1	1	2	1	1	2.5	3.0	

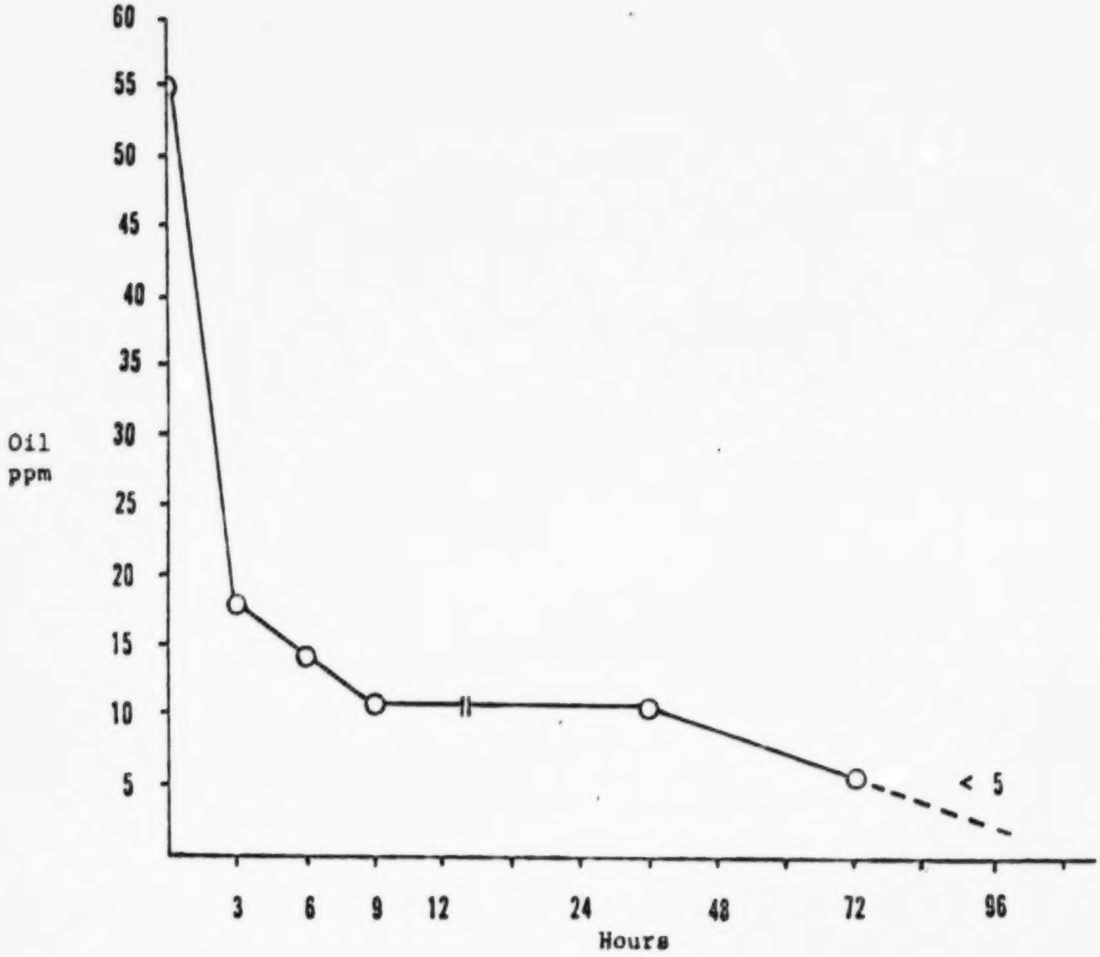
*Corrected to 760 mm, Hg. (Edminster)
KR-409 Revised 1/10/67

Item 2

Gravimetric analyses of the 5 crude oils used in laboratory and/or field experiments

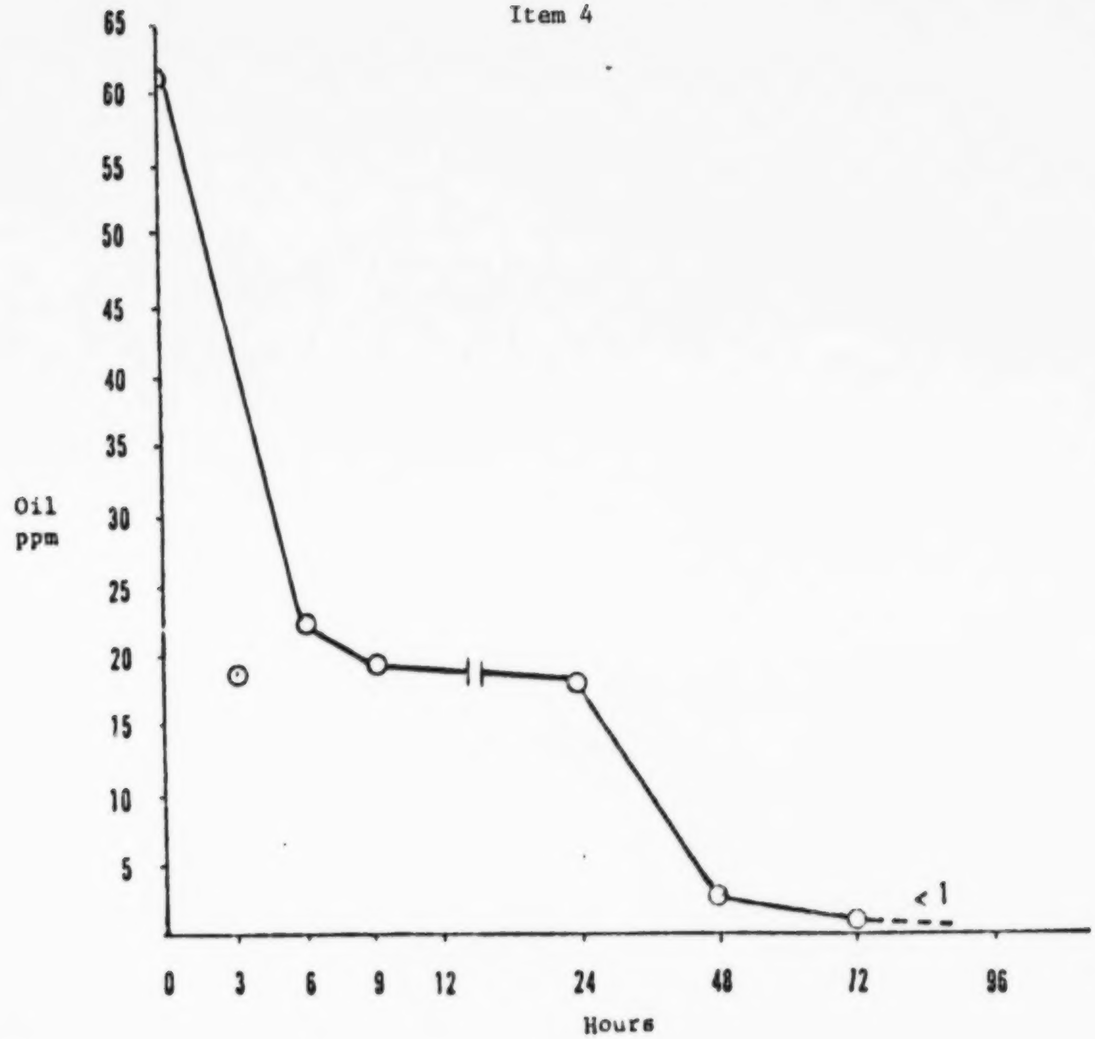
	Saudi Arabian	Empire Mix	Nigerian	Iranian	Venezuelan
Pristane/phytane	0.65	1.77	0.73	0.74	1.80
C_{17}/pristane	5.68	1.23	0.92	1.59	1.32
C_{18}/phytane	2.98	1.65	2.56	1.56	1.25
% Aliphatic Hydrocarbons	41.45	74.96	83.40	47.50	50.30
% Aromatic Hydrocarbons	31.78	21.60	14.60	22.70	23.80
% Polar Components	5.41	4.73	---	---	---
% Volatiles	43.23	39.57	71.50	41.00	29.00

Item 3



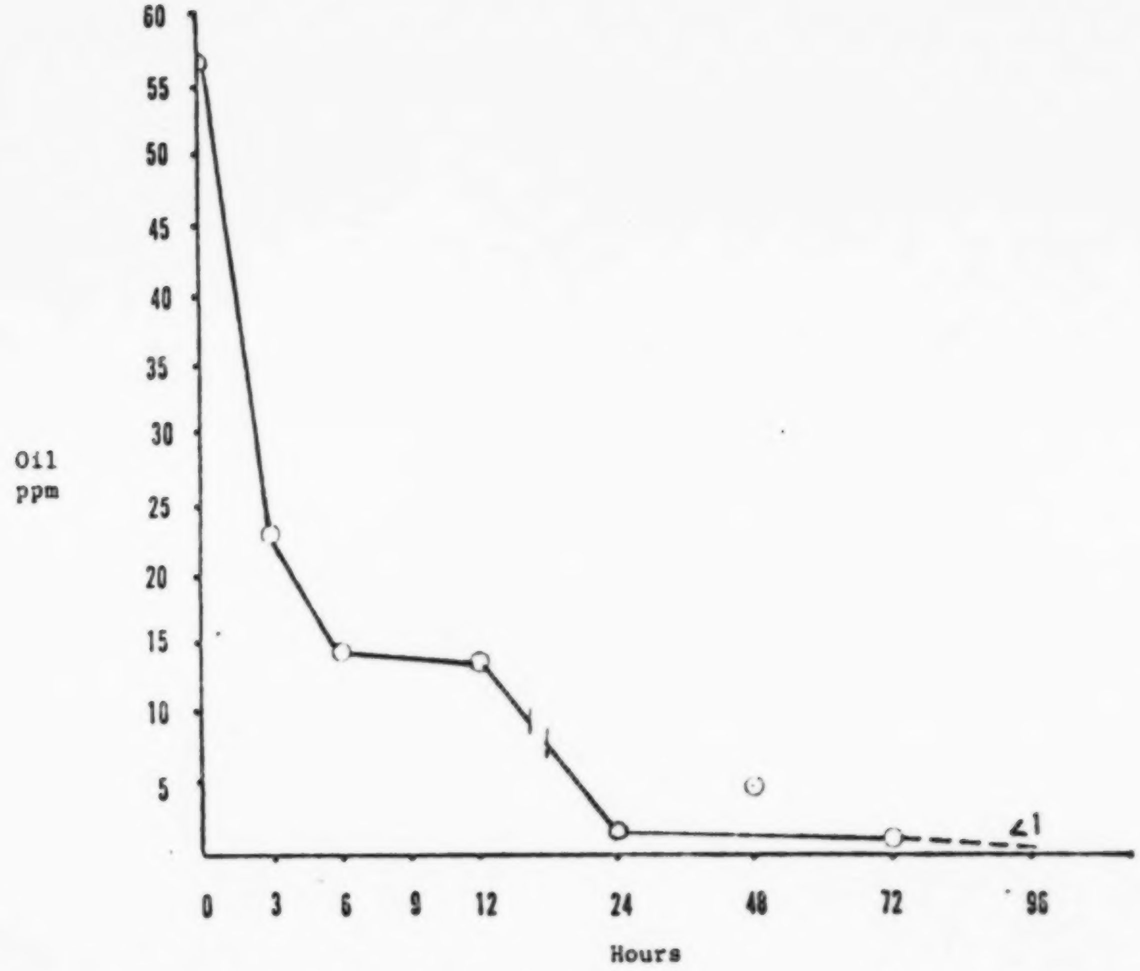
Change in oil concentration with time using subsurface dynaflow with 150 ppm Empire Mix Crude Oil.

Item 4

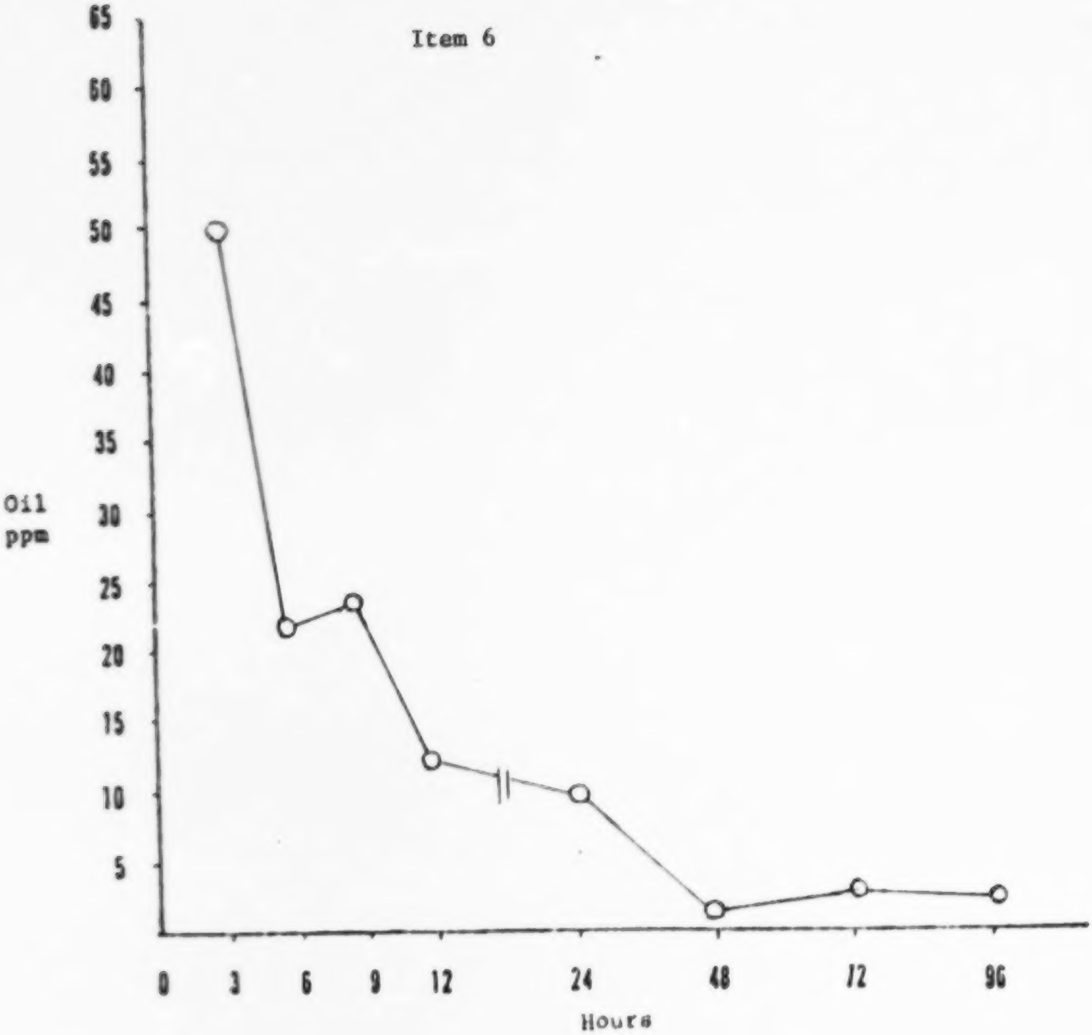


Changes in oil concentration with time using subsurface dynaflow plus bubbler with 150 ppm emulsified Empire Mix Crude Oil.

Item 5

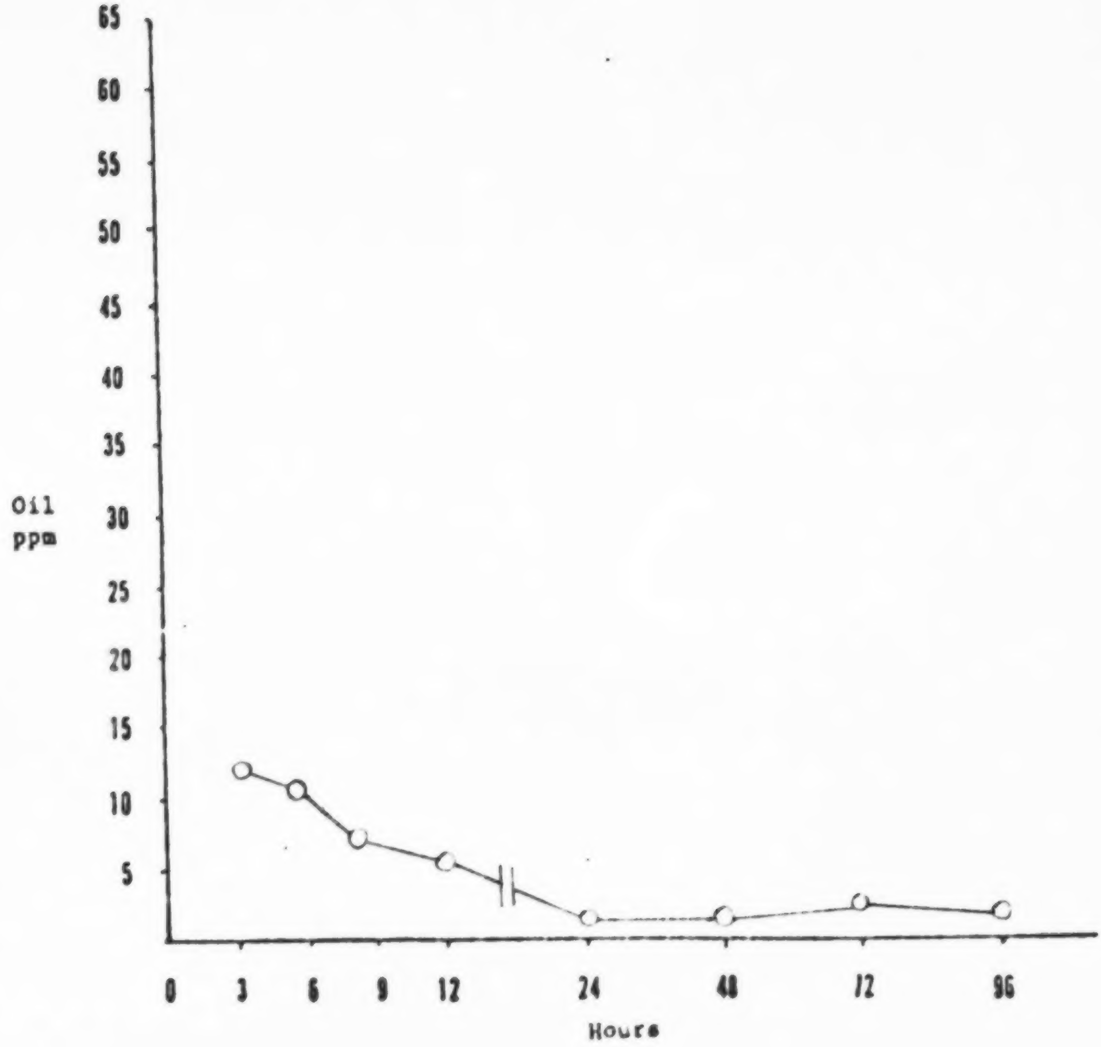


Change in oil concentration with time using subsurface dynaflow plus sediment with 150 ppm Empire Mix Crude Oil.



Changes in oil concentration with time using subsurface dynaflow plus bubbler with 200 ppm emulsified Empire Mix crude oil.

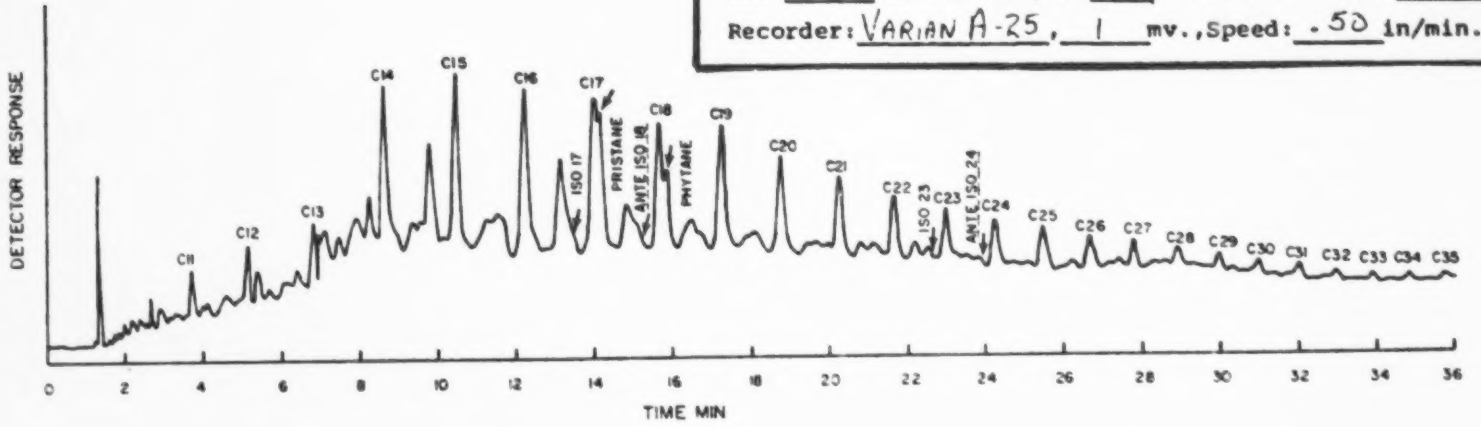
Item 7



Change in concentration with time using subsurface dynaflow plus sediment with 275 ppm Saudi Arabian crude oil.

Item 8

Sample: Empire Crude HC Adducts Date: 5/29/73
Instrument: Perkin Elmer 990 Operator: J. Lytle
Dectector: FID, Temp: 300 °C., ______ V, ________ ma
Column: SE-30 8' x 1/8" od
Stainless Steel
Column Temp: 80-300 °C., Prog. Rate: 6 °C/min.
Carrier Gas: Helium Flow: 35 cc/min.
Pressure: 55 psig, Scavenger: — cc/min, H_2 30 cc/min.
Air: 300 cc/min., Sample: 1/2 µl., Attenuation: 1x1024
Recorder: Varian A-25, 1 mv., Speed: .50 in/min.

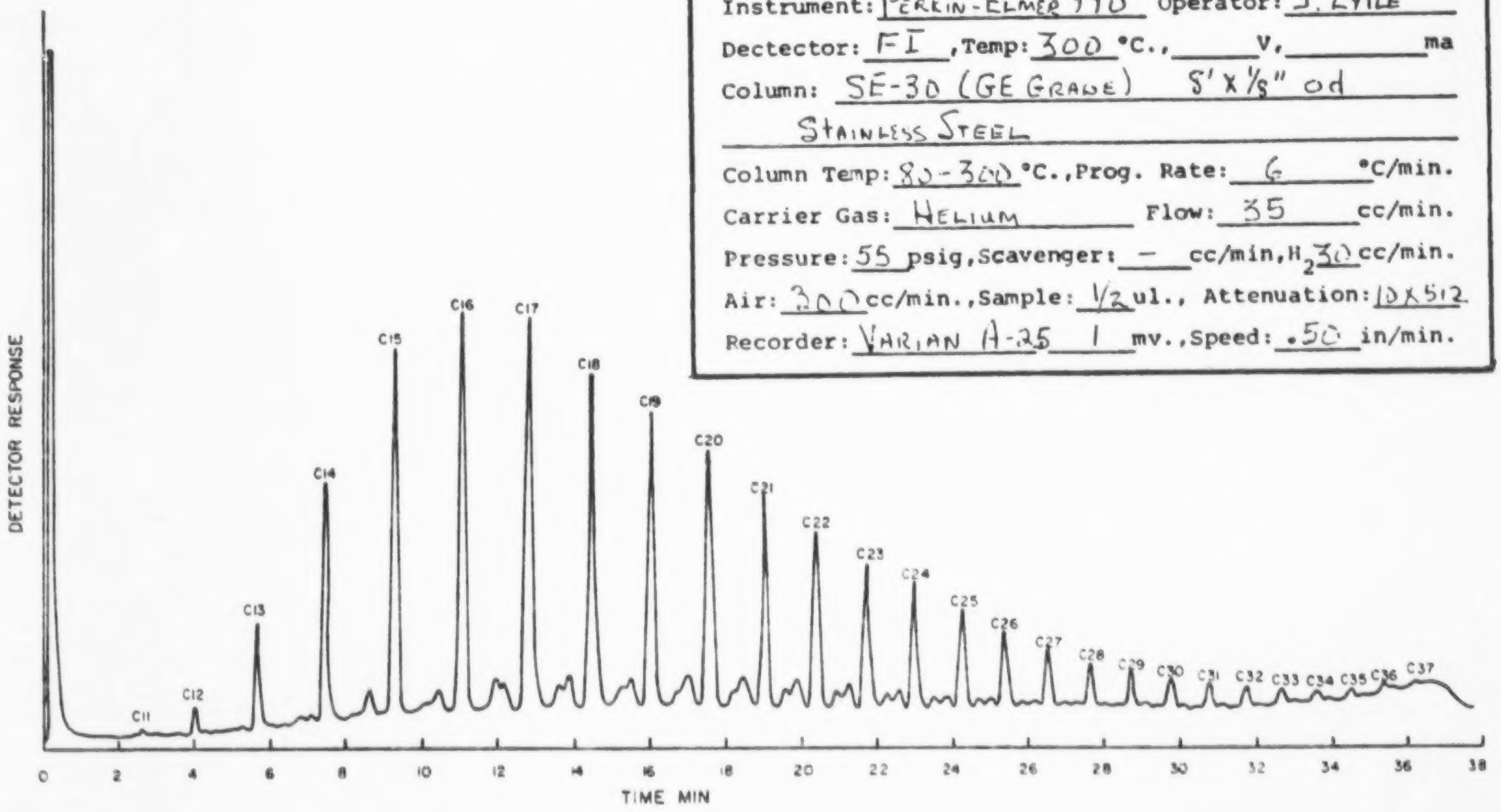


Empire Crude Oil GCL Analysis

The aliphatic hydrocarbons were separated into branched-cyclic and straight chain hydrocarbons using urea clathrate techniques. The adducts represent the straight-chain hydrocarbons. See also Figure 5.

Item 9

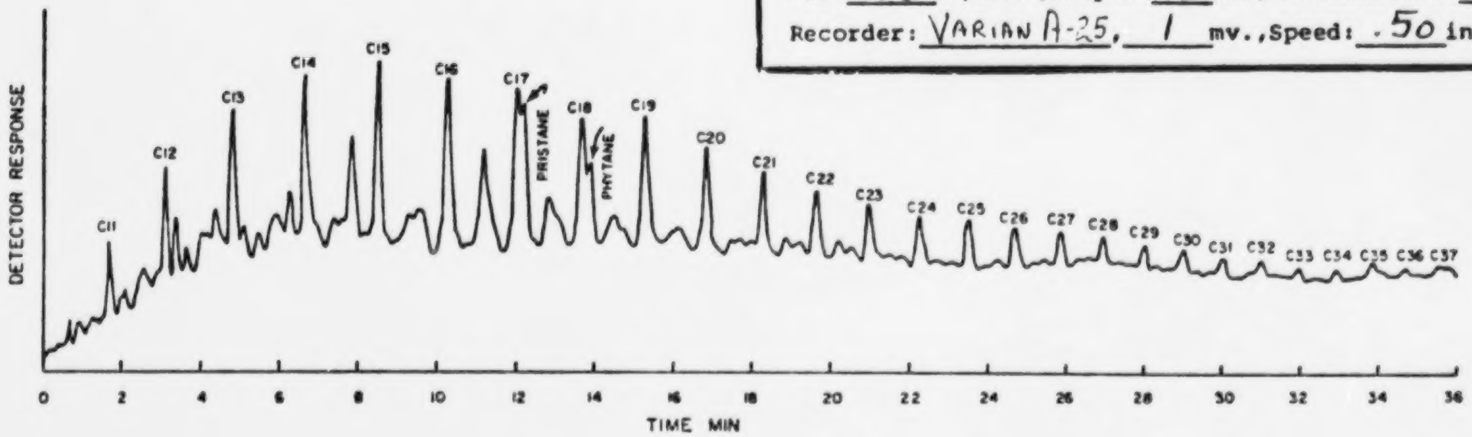
Sample: Empire Crude HC (Aliphatic) Date: 5/30/73
Instrument: Perkin-Elmer 990 Operator: J. Lytle
Dectector: FI ,Temp: 300 °C., ____ V, ____ ma
Column: SE-30 (GE Grade) 8' x 1/8" od
Stainless Steel
Column Temp: 80-300 °C., Prog. Rate: 6 °C/min.
Carrier Gas: Helium Flow: 35 cc/min.
Pressure: 55 psig, Scavenger: — cc/min, H_2 30 cc/min.
Air: 300 cc/min., Sample: 1/2 ul., Attenuation: 10 x 512
Recorder: Varian A-25 1 mv., Speed: .50 in/min.



Empire Crude Oil GCL Analysis; Total Hexane Fraction off Silica Gel

This chromatogram shows the total aliphatic hydrocarbons in the oil.

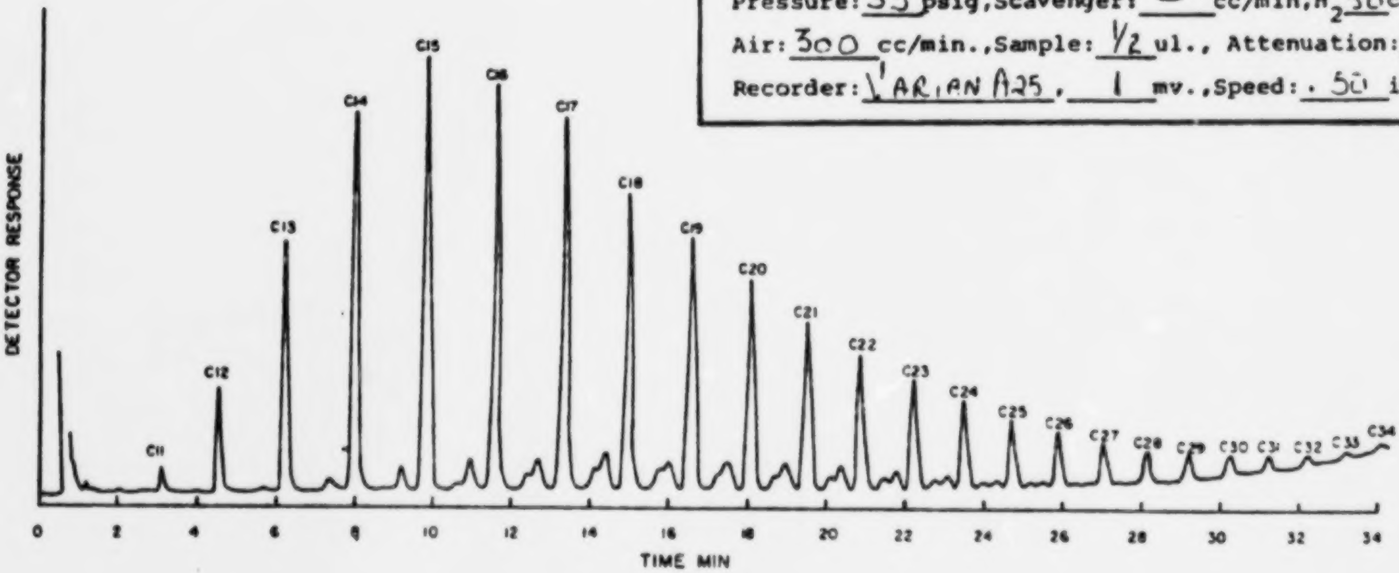
Sample: TOTAL ALIPHATICS IN 400 PPM CRUDE OIL SLURRY SEDIMENTS Date: 5/29/73
Instrument: PERKIN-ELMER 990 Operator: J LYTLE
Dectector: FID, Temp: 300 °C., ____ V, ____ ma
Column: SE-30 8' x 1/8" o.d.
STAINLESS STEEL
Column Temp: 80-300 °C., Prog. Rate: 6 °C/min.
Carrier Gas: HELIUM Flow: 35 cc/min.
Pressure: 55 psig, Scavenger: - cc/min, H_2 30 cc/min.
Air: 300 cc/min., Sample: 1/2 ul., Attenuation: 10X256
Recorder: VARIAN A-25, 1 mv., Speed: .50 in/min.



Chemical Degradation of Oil in Sediments.

400 ppm crude oil slurried into 1" bottom sediments. System allowed to operate for 96 hours and then the water was pumped off carefully and the sediments collected and chemically analyzed for total hydrocarbons. This fraction shows total aliphatic HC's.

Sample: 400 ppm Adduct + Oil Slurry + Sediments Date: 5-29-73
Instrument: Perkin Elmer 990 Operator: J. Lytle
Dectector: FID, Temp: 300 °C., ______ V, ______ ma
Column: SE-30 8' x 1/8" o.d.
Stainless Steel
Column Temp: 80-300 °C., Prog. Rate: 6 °C/min.
Carrier Gas: Helium Flow: 35 cc/min.
Pressure: 55 psig, Scavenger: — cc/min, H_2 30 cc/min.
Air: 300 cc/min., Sample: 1/2 ul., Attenuation: 1x512
Recorder: Varian A25, 1 mv., Speed: .50 in/min.



Degradation of Oil in Sediments

400 ppm crude oil slurried into 1" bottom sediments. System allowed to operate for 96 hours and then the water was carefully pumped off and the sediments collected and chemically analyzed for total hydrocarbons. This fraction shows only the straight-chain adduct.

Gravimetric data obtained periodically during the 9 mo degradation study of Empire Mix crude oil in salt water and in salt water containing dead marsh plant material (*Spartina alterniflora*). Jars without aeration were tightly sealed and placed in a dark cabinet while those with aeration were left open in indirect sunlight and supplied with a low flow of air.

Without Aeration

	Oil and Saltwater				Oil, Saltwater and *Spartina*				
	1*	2	3	4	1	2	3	4	5
Pristane/phytane	1.81	1.90	1.77	1.78	1.86	1.82	1.83	1.82	1.87
C_{17}/pristane	1.16	1.03	1.12	1.12	1.13	1.19	1.19	1.19	1.17
C_{18}/phytane	1.61	1.40	1.57	1.60	1.67	1.67	1.71	1.69	1.66
% Aliphatics	61.30	71.40	64.00	65.40	61.30	66.00	68.60	56.80	58.90
% Aromatics	22.60	16.90	13.60	18.10	26.00	12.90	12.00	16.30	13.80

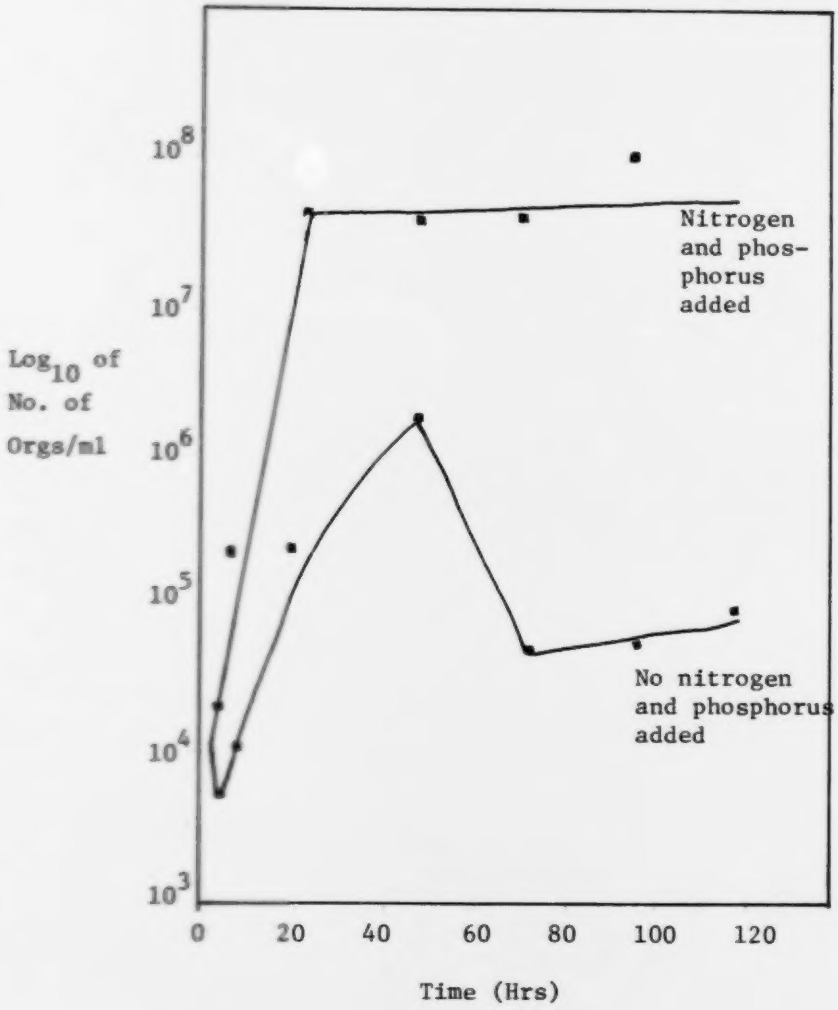
With Aeration

	Oil and Saltwater				Oil, Saltwater and *Spartina*				
	1	2	3	4	1	2	3	4	5
Pristane/phytane	1.86	1.76	1.87	1.81	1.81	1.75	1.75	1.78	1.57
C_{17}/pristane	1.09	1.17	1.13	1.12	.748	.752	.623	.665	.487
C_{18}/phytane	1.54	1.68	1.67	1.86	1.04	1.02	.802	.849	.586
% Aliphatic	48.00	67.70	46.30	54.70	67.60	36.20	51.30	57.40	43.50
% Aromatic	22.20	15.30	11.30	15.80	25.90	10.20	14.10	19.80	14.30

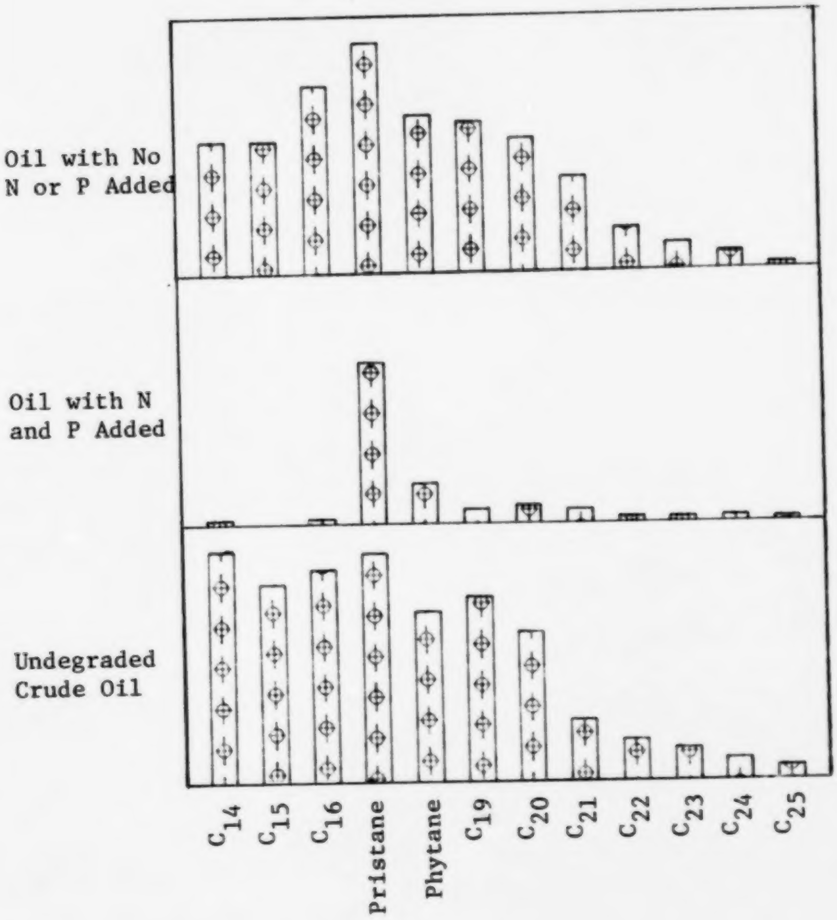
*Sampling Dates: 1 - 6 December 1974; 2 - 8 January 1975; 3 - 5 February 1975; 4 - 17 April 1975; 5 - 19 June 1975

Item 13

The growth of hydrocarbon-metabolizing microorganisms in the presence of added nitrogen and phosphorous.

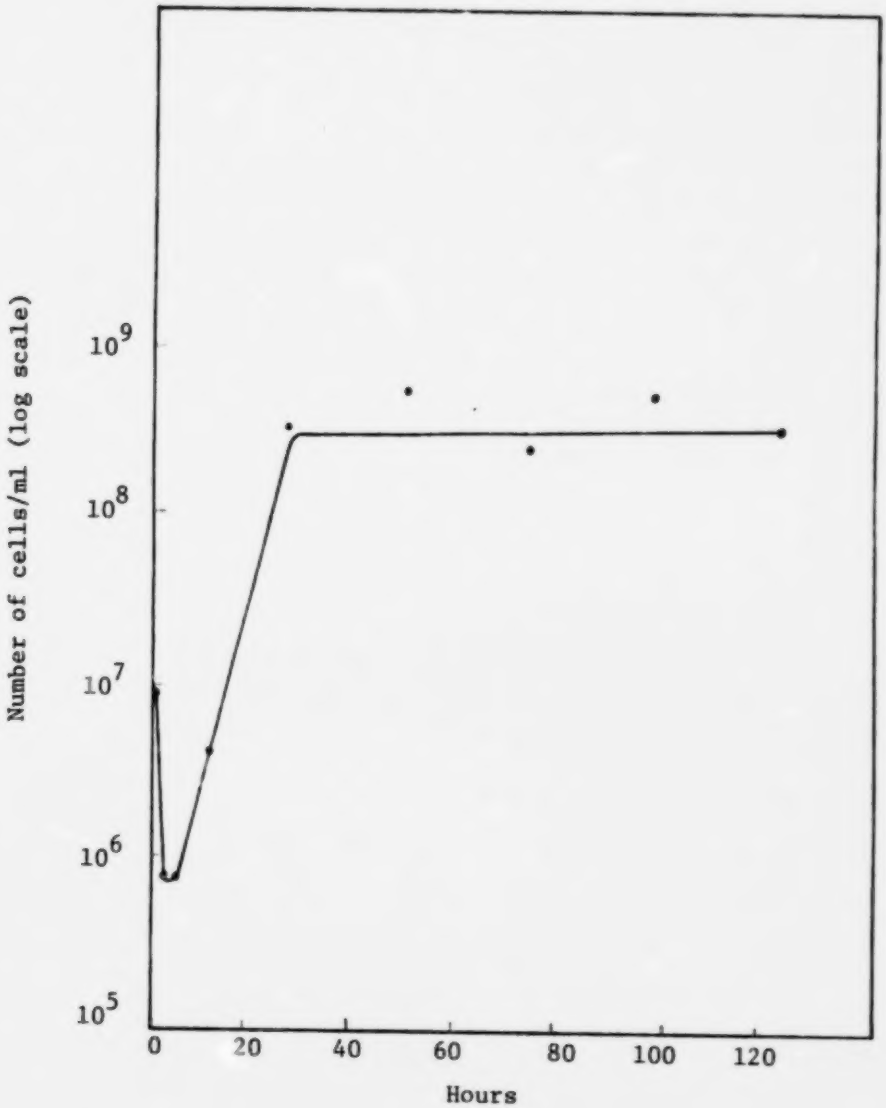


Item 14



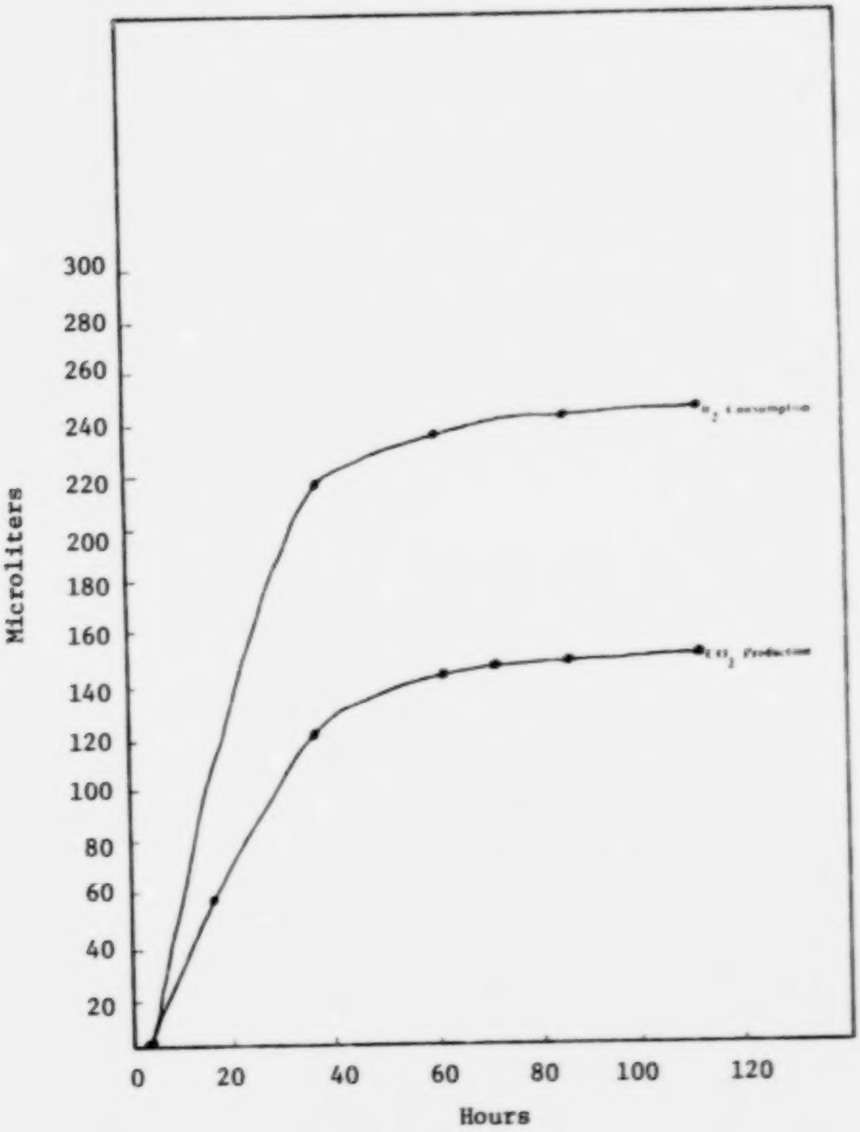
The effect of N and P on the aliphatic fraction of Empire Mix crude oil after 120 h of incubation. Note: Bar graph adapted from G.C. chromatograms. Bar height = peak height.

Item 15



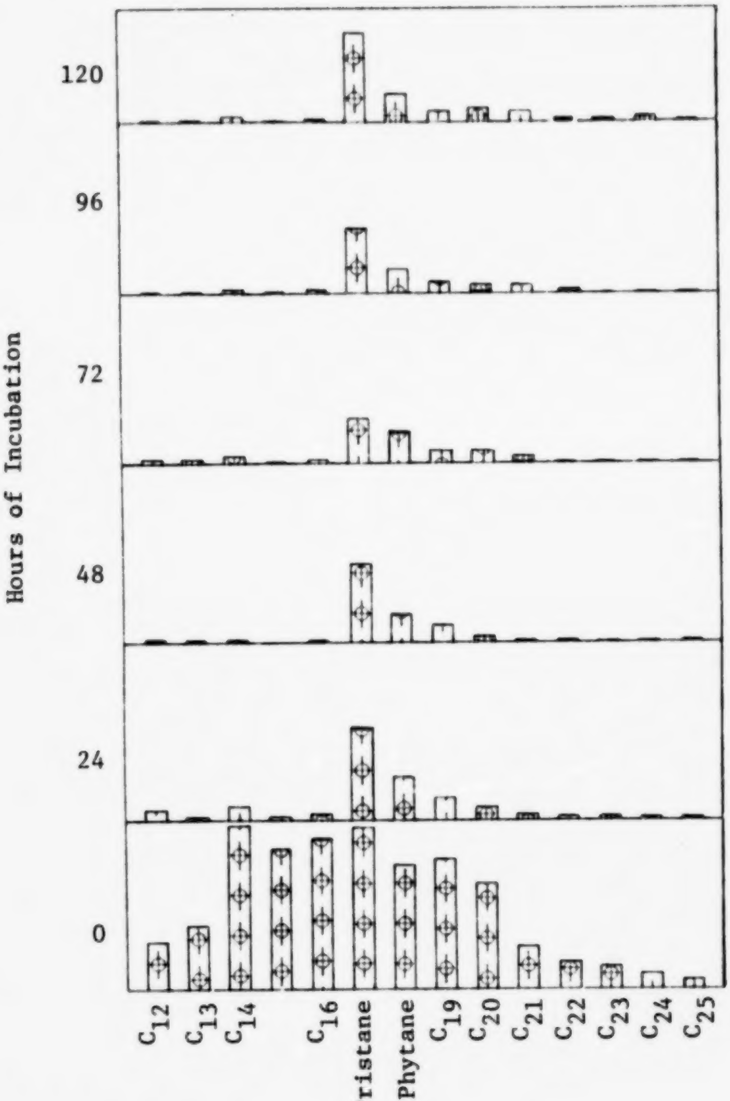
Changes in conc. of microorganisms during growth on Empire Mix crude oil for 120 h.

Item 16



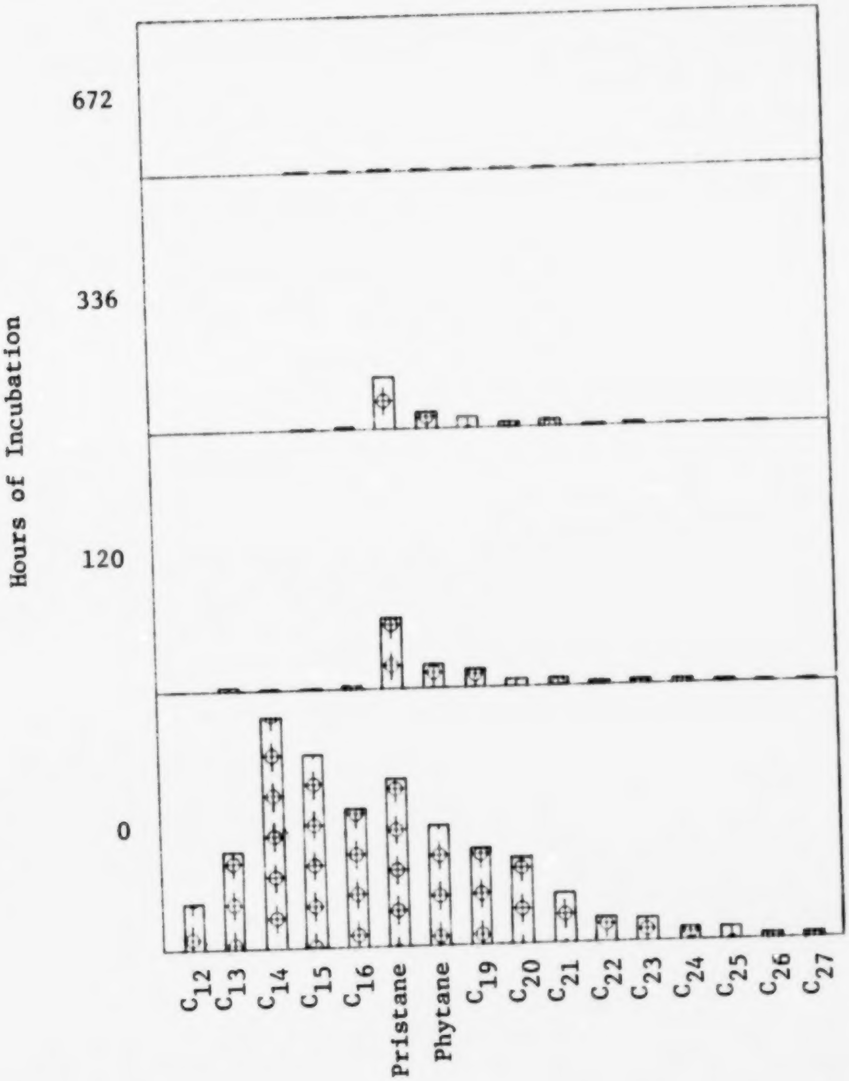
Oxygen consumption and carbon dioxide production during incubation. Note: Medium was Empire Mix crude oil in supplemented synthetic seawater.

Item 17



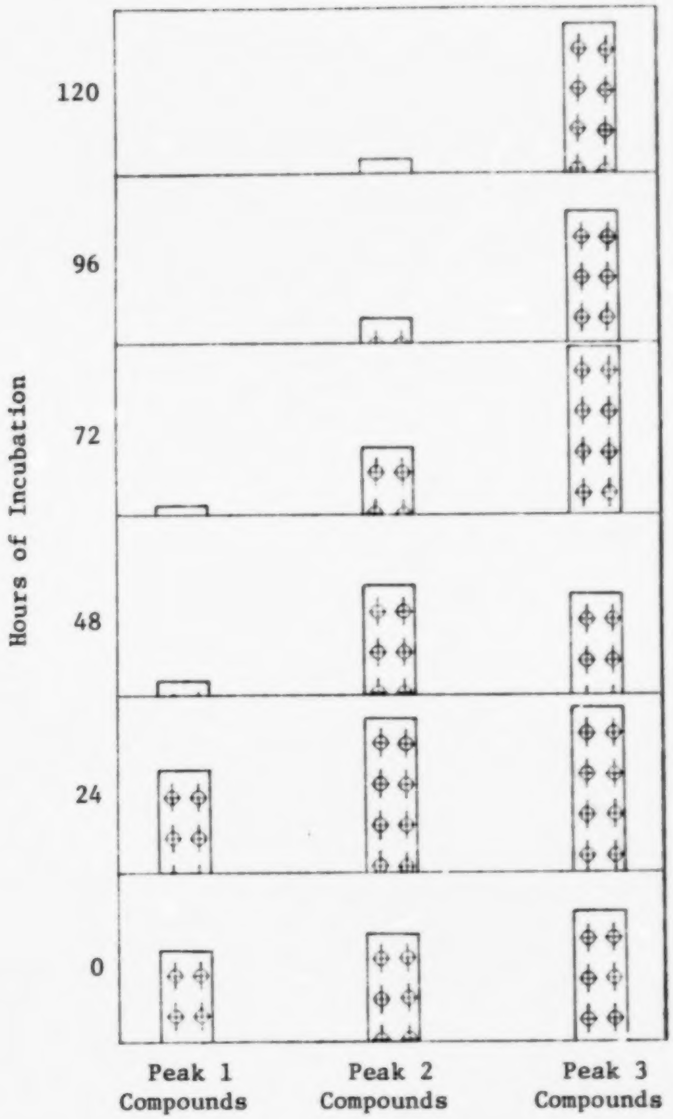
The aliphatic fraction of Empire Mix crude oil during incubation for 120 h. Note: Bar graph adapted from G.C. chromatograms. Bar height = peak height.

Item 18



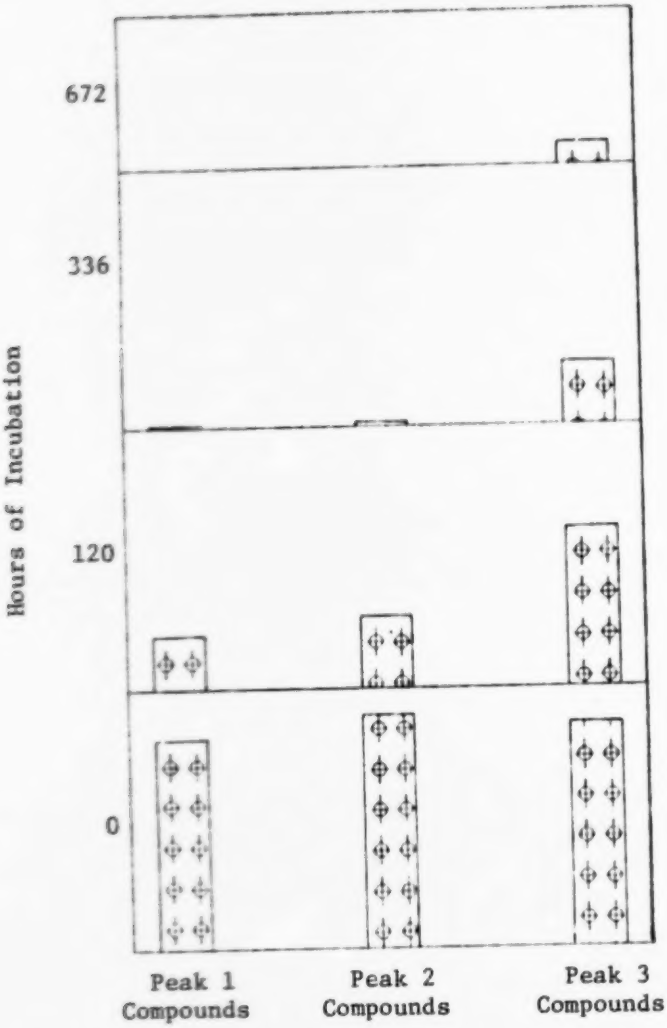
The aliphatic fraction of Empire Mix crude oil after extended incubation. Note: Bar graph adapted from G.C. chromatograms. Bar height = peak height.

Item 19



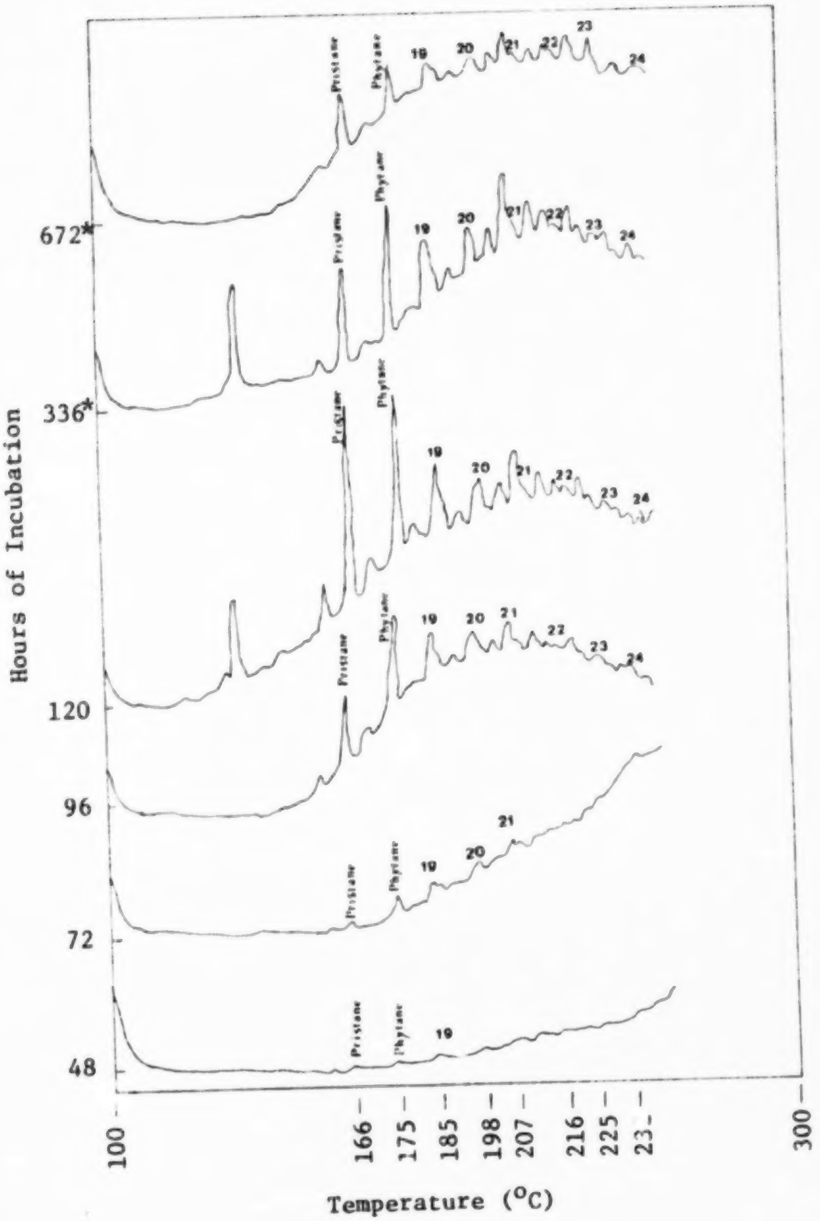
The aromatic fraction of Empire Mix crude oil during incubation for 120 h. Note: Bar graph adapted from L.C. chromatograms. Bar height = peak height.

Item 20



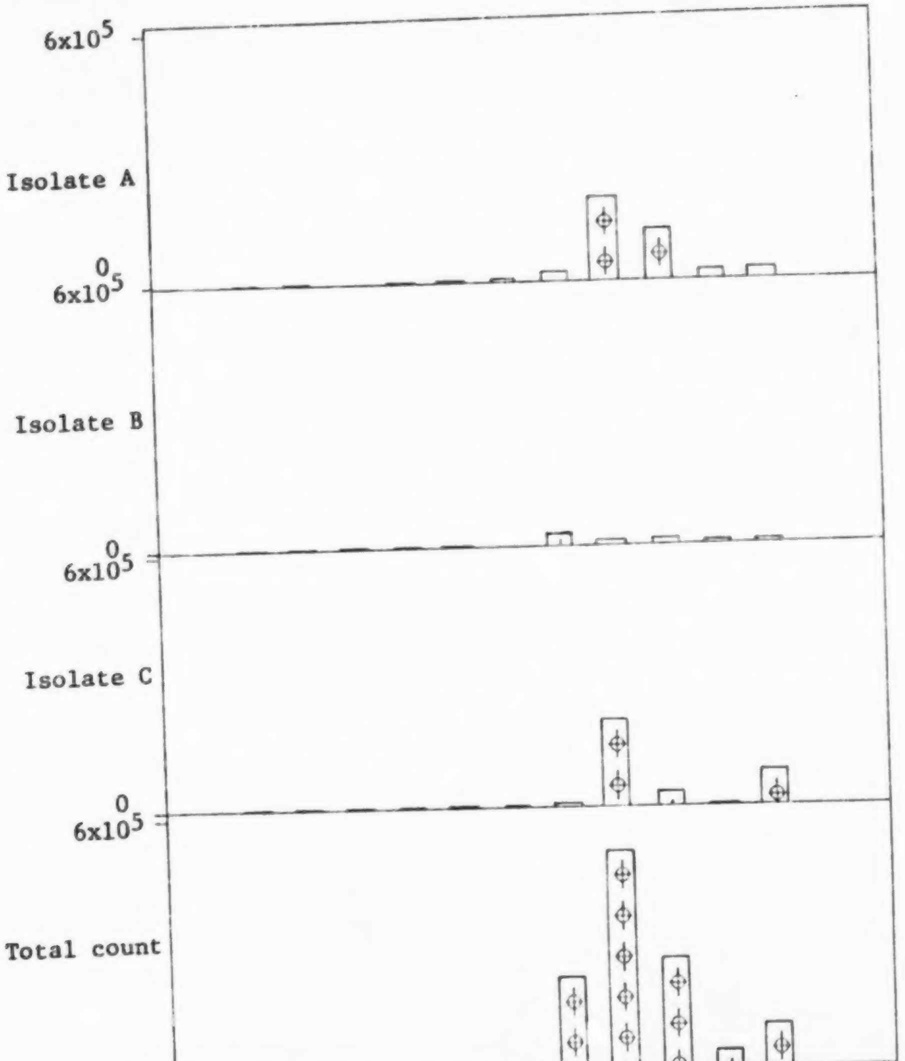
The aromatic fraction of Empire Mix crude oil after various times of incubation. Note: Bar graph adapted from L.C. chromatograms. Bar height = peak height.

Item 21



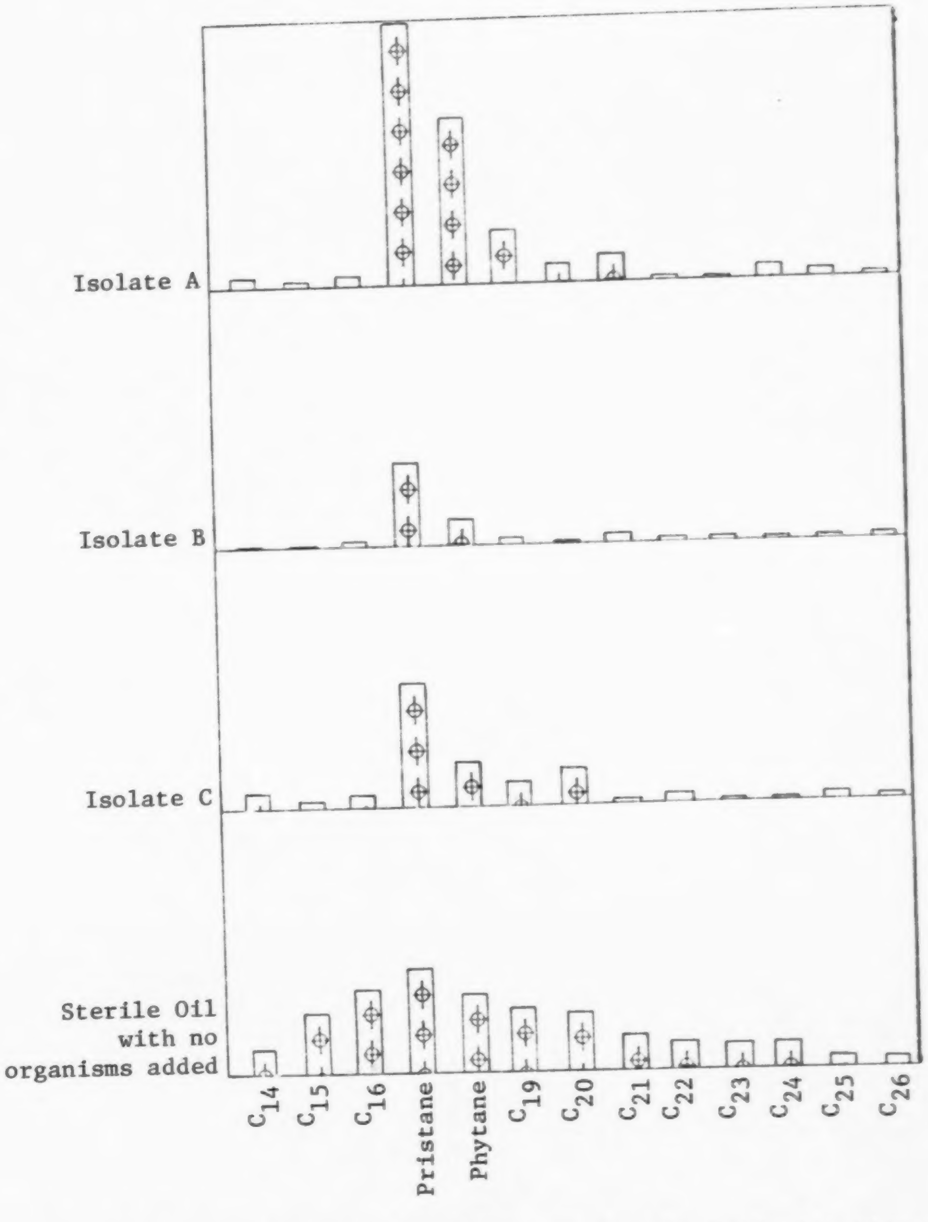
Gas chromatographic tracing of the aliphatic content of cells grown on Empire Mix crude oil for various time intervals. Note: Cells from the 336 h and 672 h samples were from a previous experiment.

Item 22



Differential counts of isolates A, B and C at various incubations.

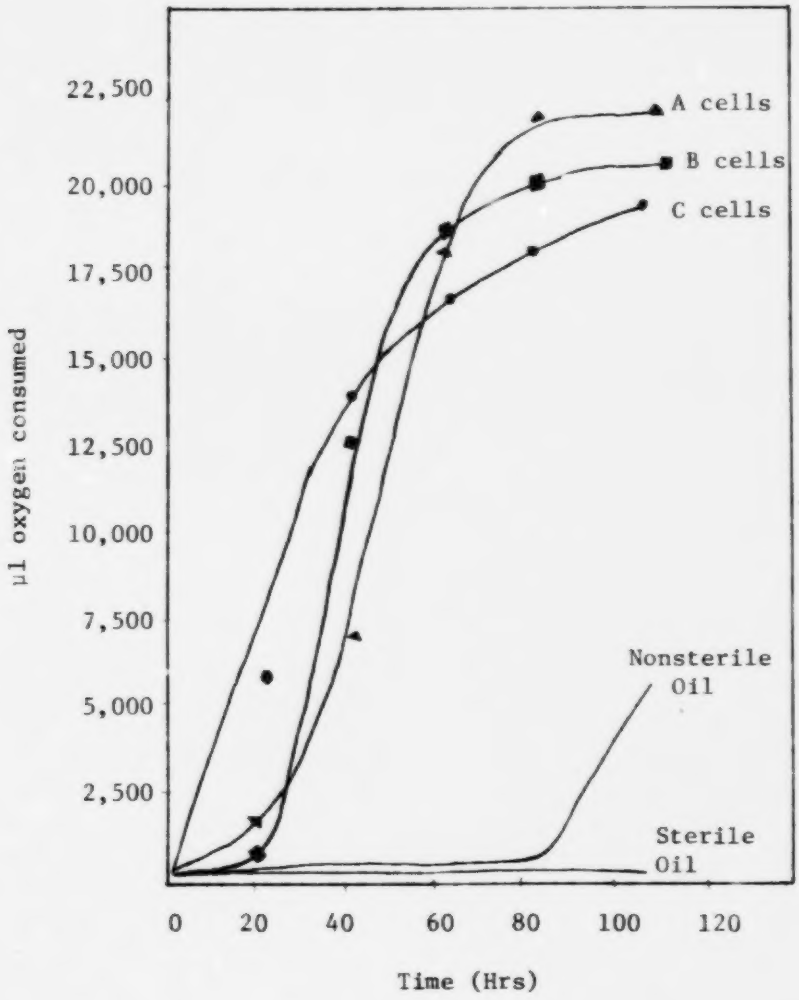
Item 23



The effect of three pure cultures on the aliphatic fraction of Empire Mix crude oil after incubation for 108 h. Note: Bar graph adapted from G.C. chromatograms. Bar height = peak height.

Item 24

Oxygen consumed during 108 hrs incubation by isolates A, B, and C.



Item 25

Percent oil-in-water* emulsion as determined by IR spectrophotometric analysis for Empire Mix (EC), Iranian (IC), Nigerian (NC), Saudi Arabian (SC) and Venezuelan (VC) crude oils.

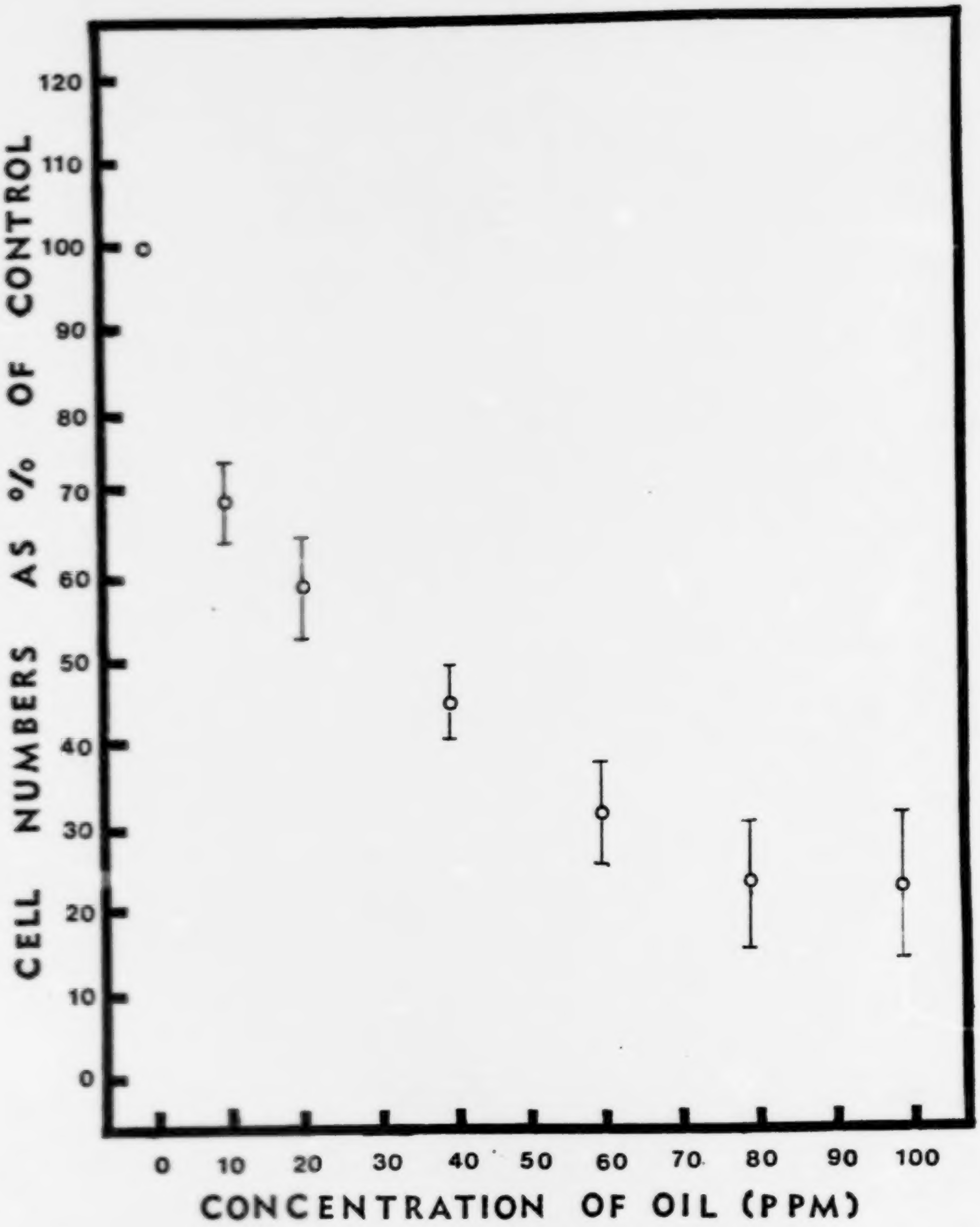
Crude Oil	% Oil-In-Water Emulsion	# Samples	Standard Deviation
EC	48	36	± 19
IC	51	20	± 23
NC	43	18	± 17
SC	54	30	± 23
VC	62	15	± 19

*These values were used to calculate the % emulsion that actually occurred in the data presented in this section of the report.

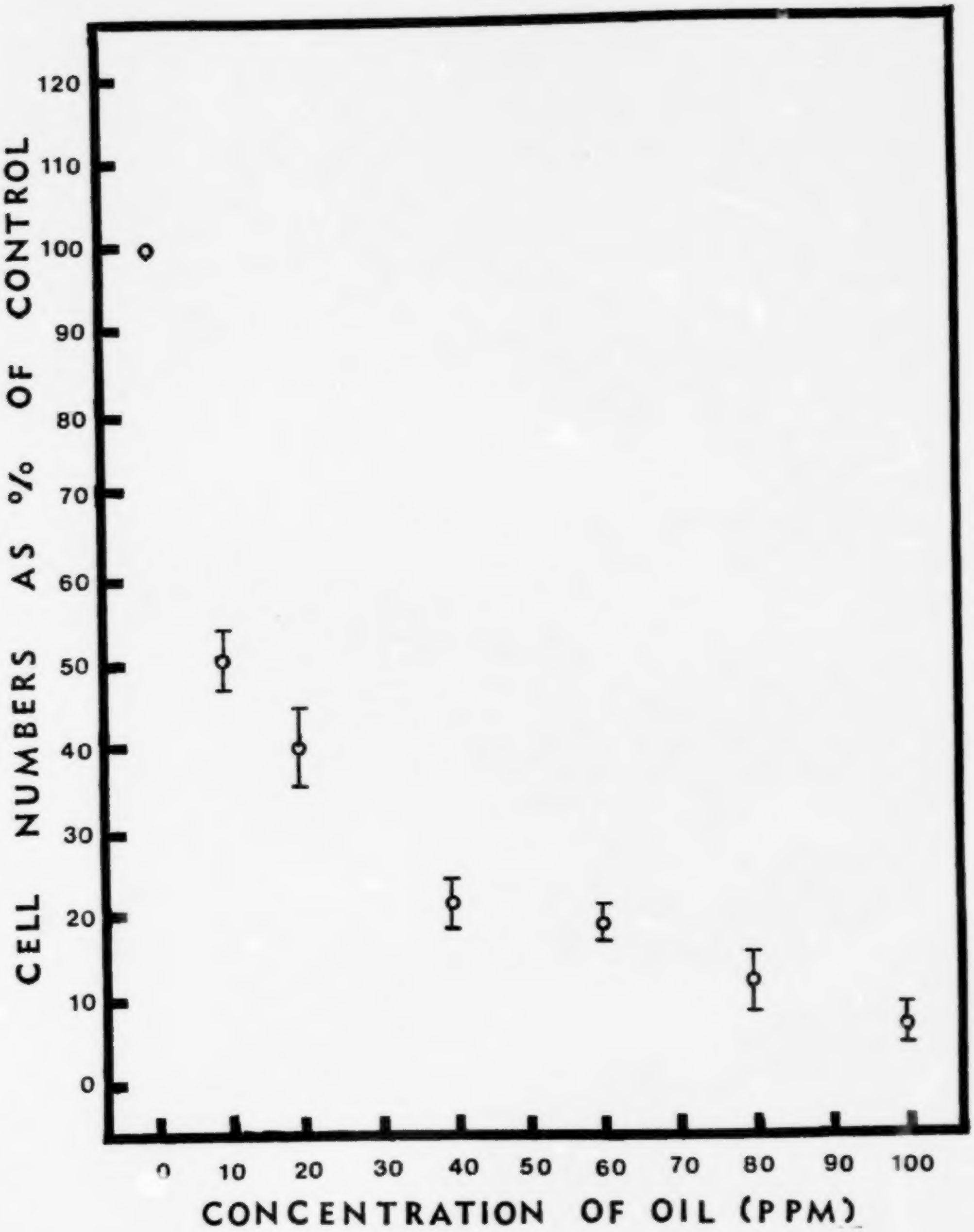
Item 26

Mean EC_{50} and standard error (SE) of representative species of marine phytoplankton exposed to crude oils for a period of 96 hrs.

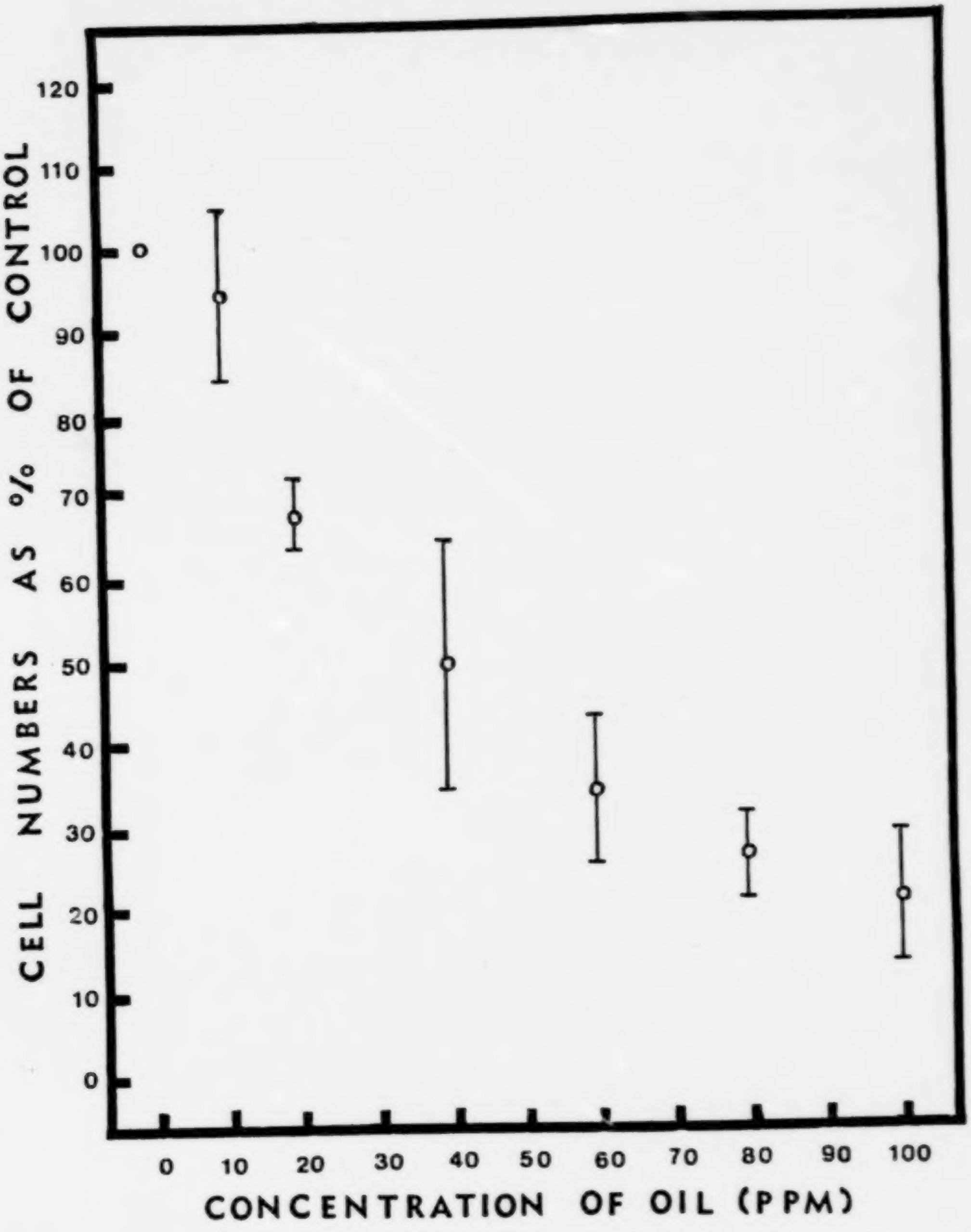
Organism	Oil	EC_{50} (96 hours)	SE
Asterionella japonica	Empire	19.4	2.5
Carteria chuii	Empire	>48.0	
Chaetoceros curvisetus	Empire	21.8	3.6
	Saudi Arabian	33.2	4.9
Isochrysis galbana	Empire	12.2	2.4
	Saudi Arabian	25.0	4.4
Lithodesmium undulatum	Empire	16.1	4.4
	Saudi Arabian	29.6	6.8
Rhizosolenia calcar	Empire	16.8	4.1
Skeletonema costatum	Empire	16.6	2.9
	Iranian	15.7	2.5
	Nigerian	5.6	0.6
	Saudi Arabian	26.9	4.7
	Venezuelan	26.9	6.0
Thalassiosira decipiens	Empire	22.5	2.0
	Saudi Arabian	>54.0	



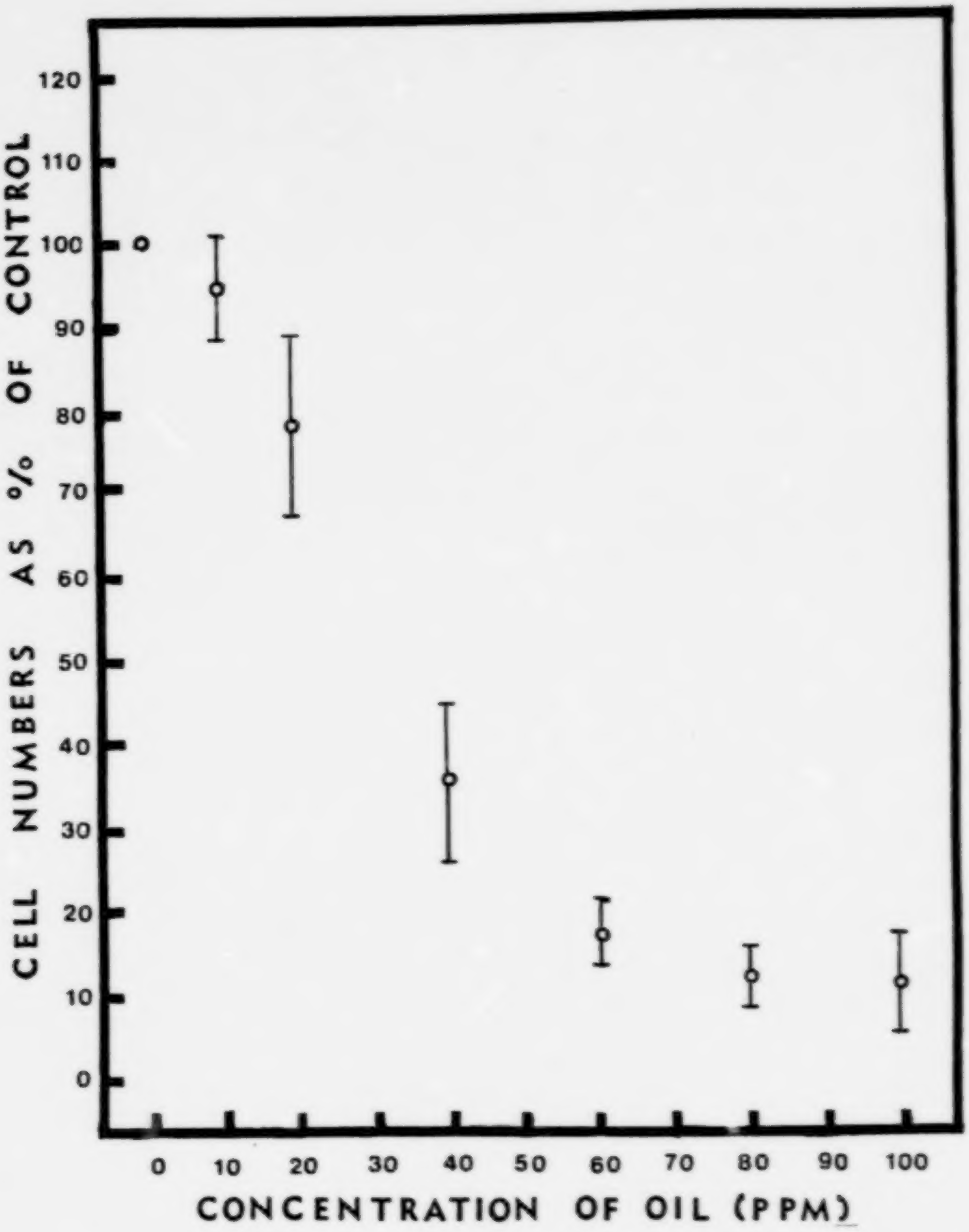
Mean and standard error of cell numbers of *Skeletonema costatum* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Iranian crude oil.



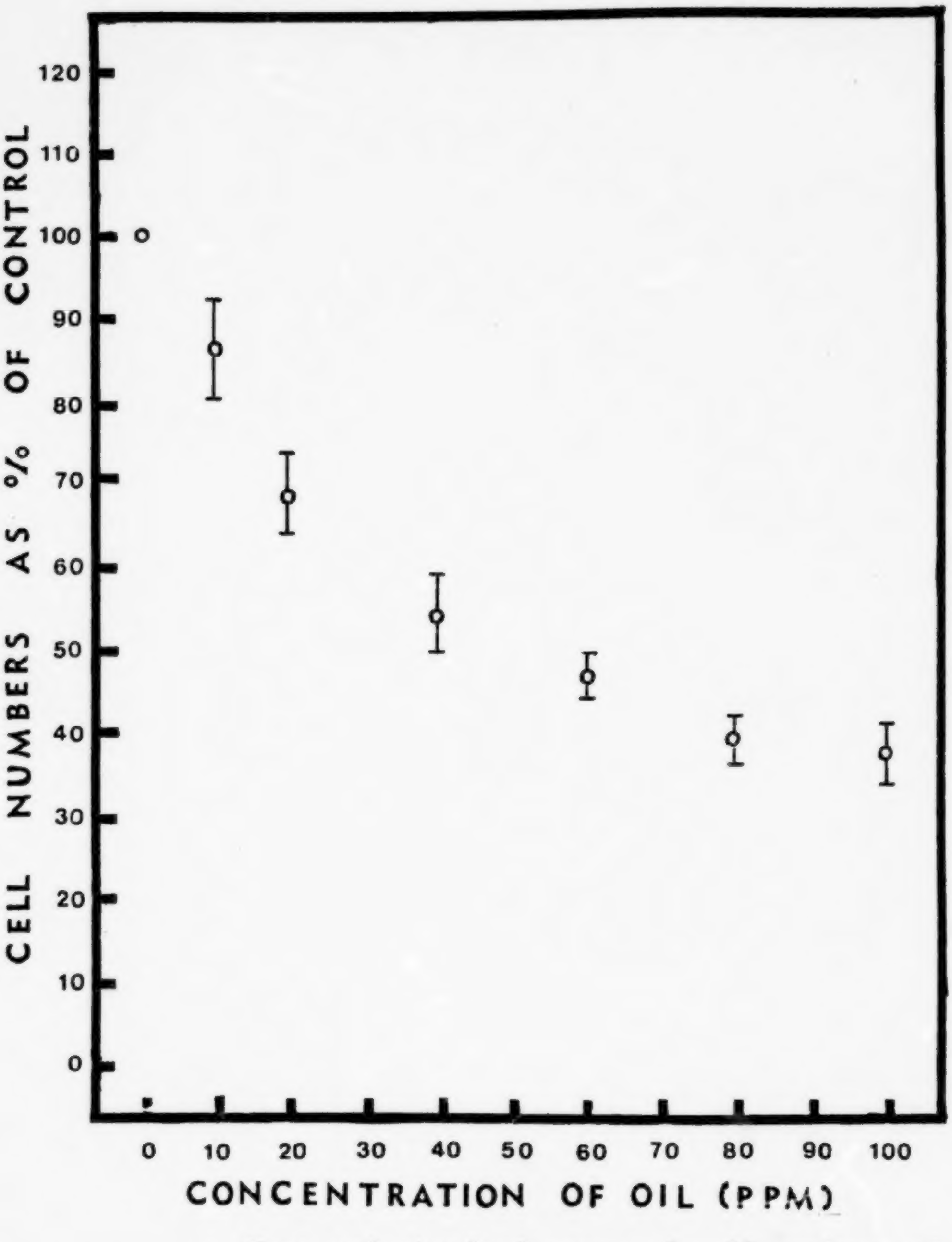
Mean and standard error of cell numbers of Skeletonema costatum expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Nigerian crude oil.



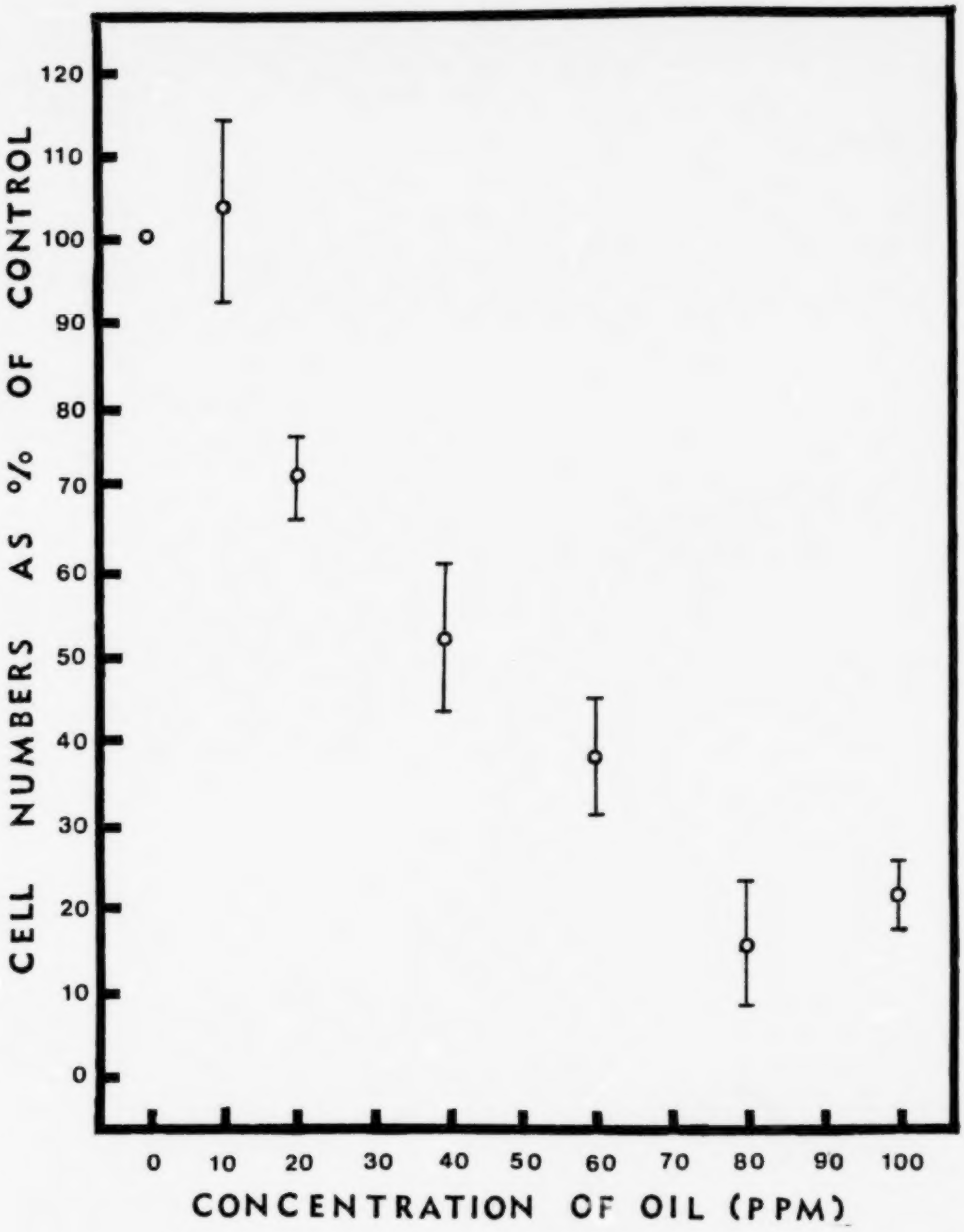
Mean and standard error of cell numbers of Skeletonema costatum expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Venezuelan crude oil.



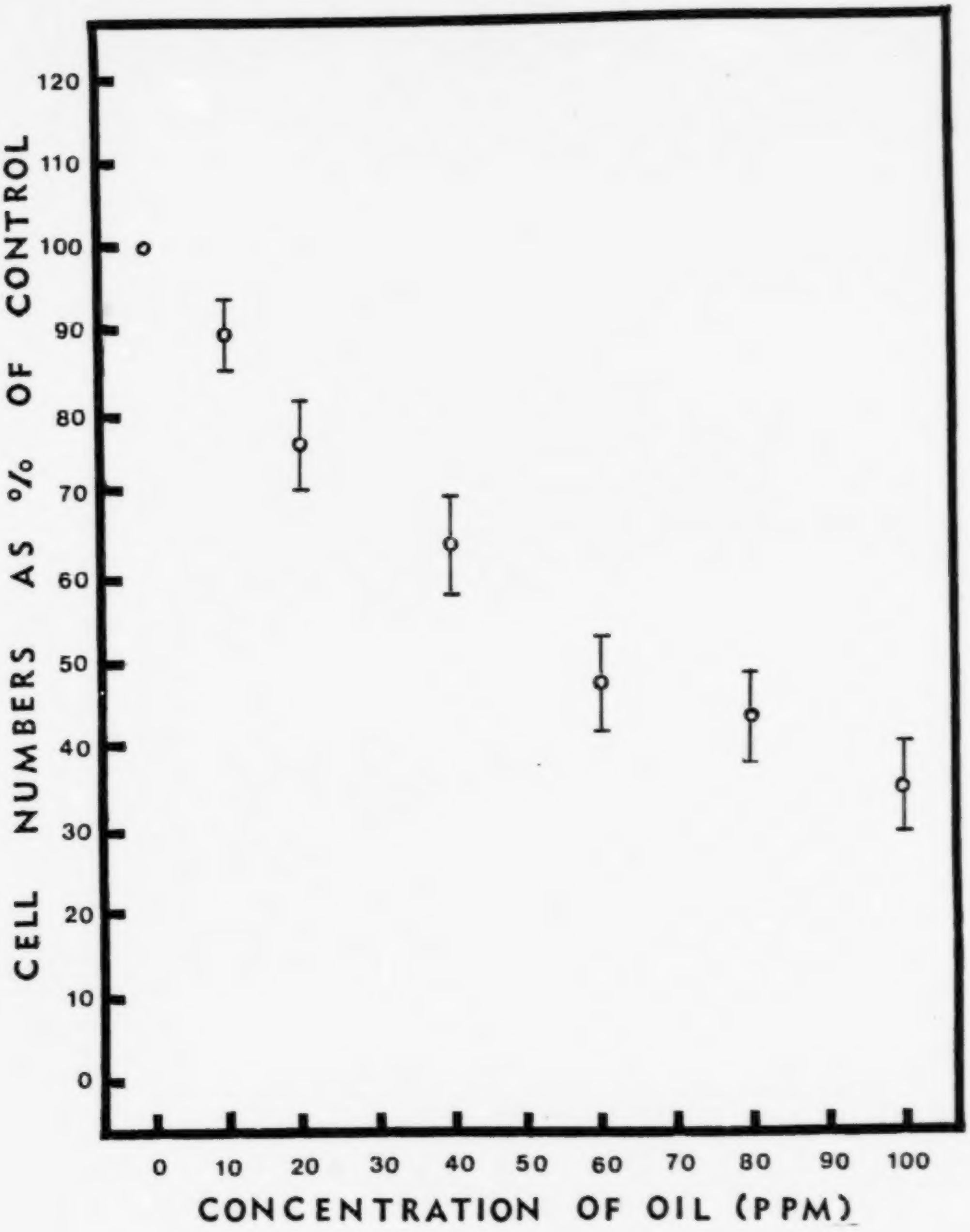
Mean and standard error of cell numbers of Skeletonema costatum expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



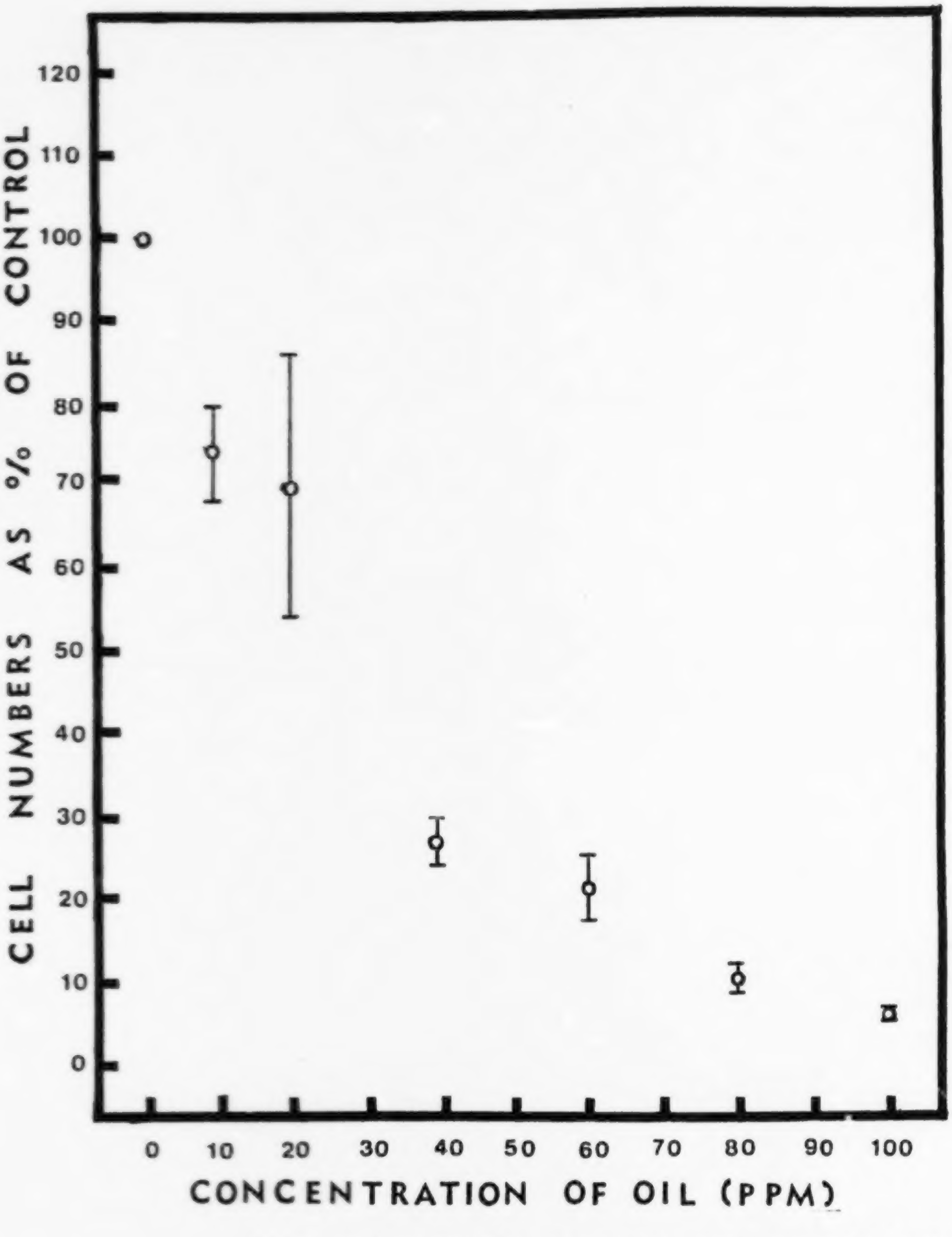
Mean and standard error of cell numbers of *Skeletonema costatum* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Saudi Arabian crude oil.



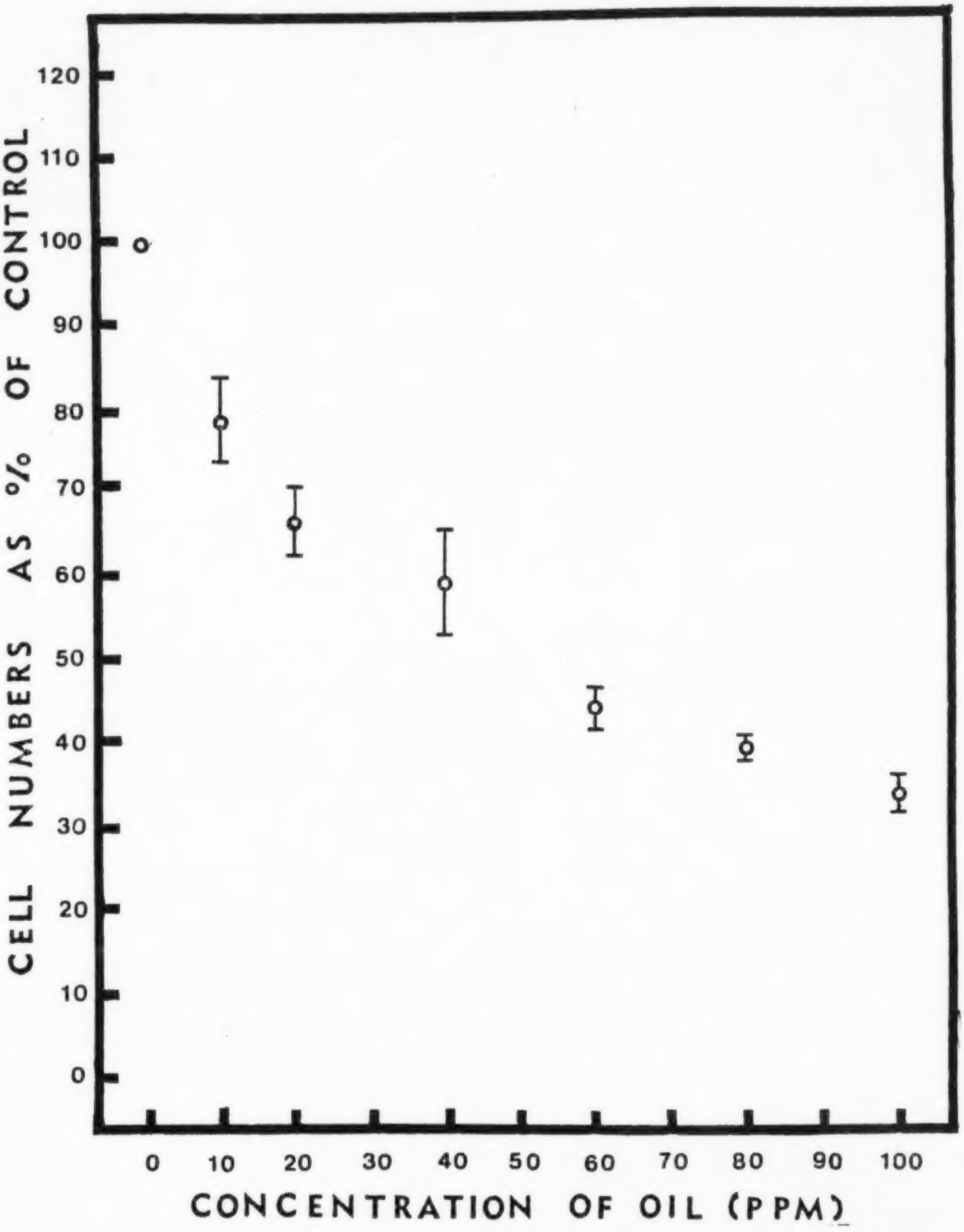
Mean and standard error of cell numbers of Chaetoceros curvisetus expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



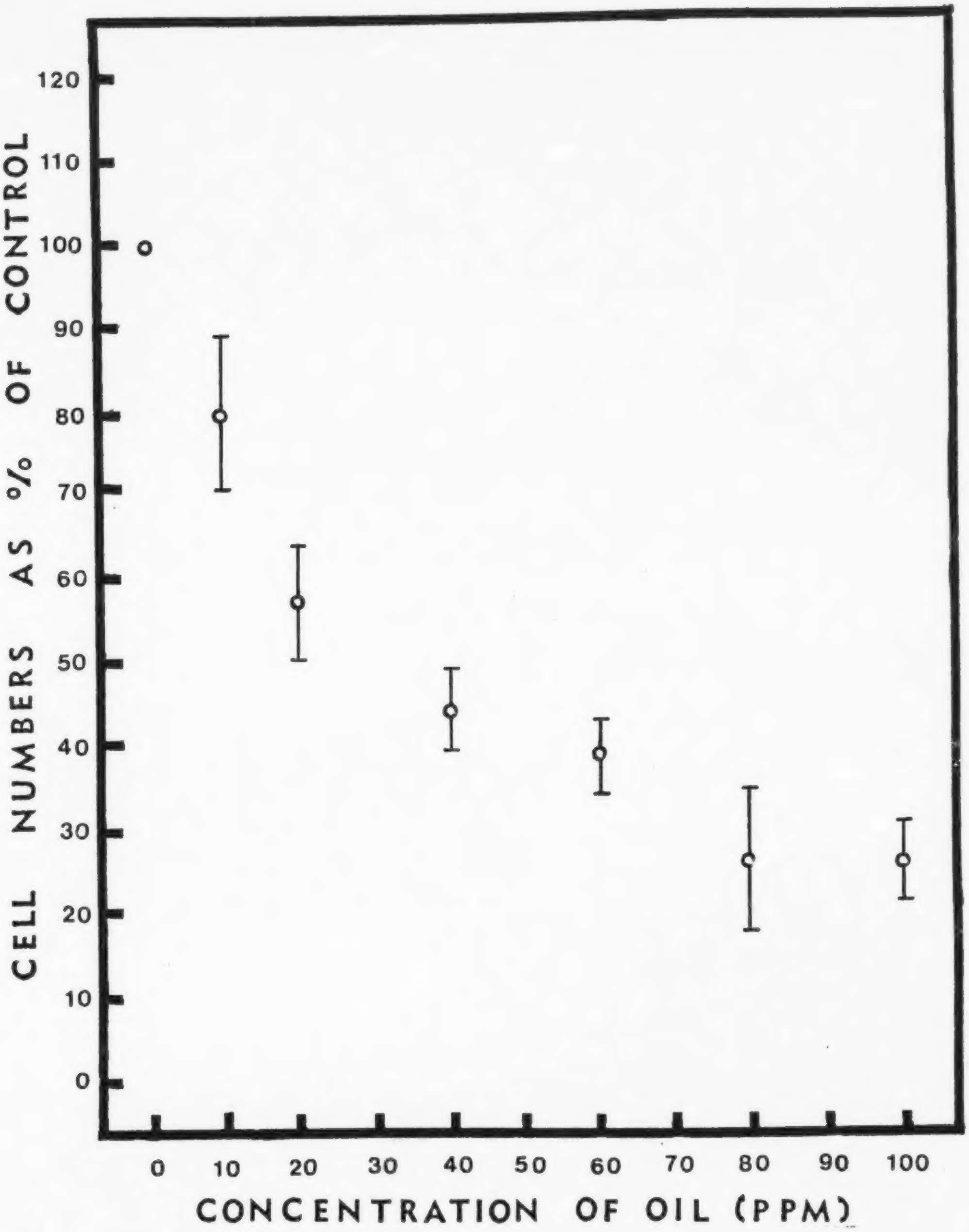
Mean and standard error of cell numbers of *Chaetoceros curvisetus* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Saudi Arabian crude oil.



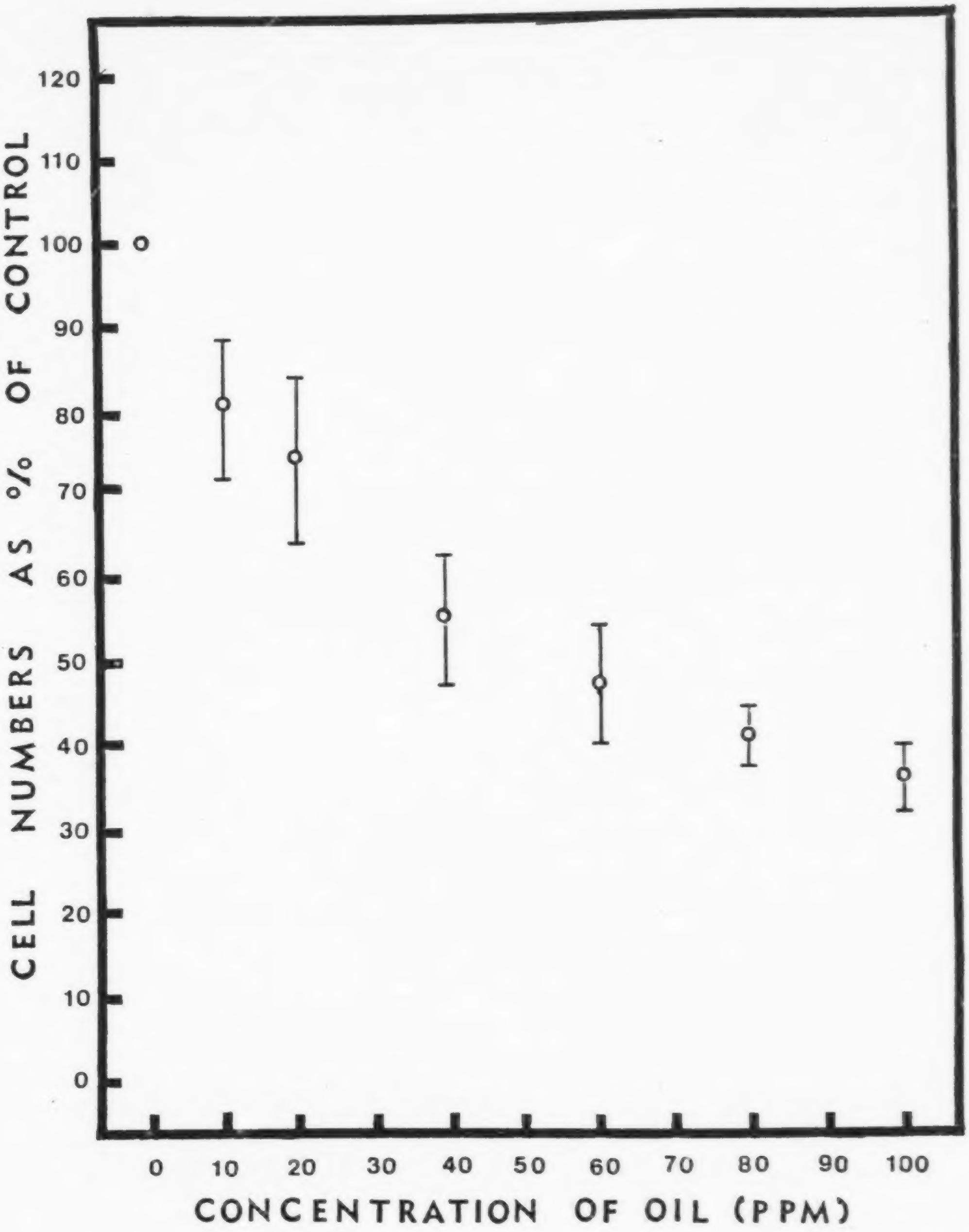
Mean and standard error of cell numbers of *Isochrysis galbana* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



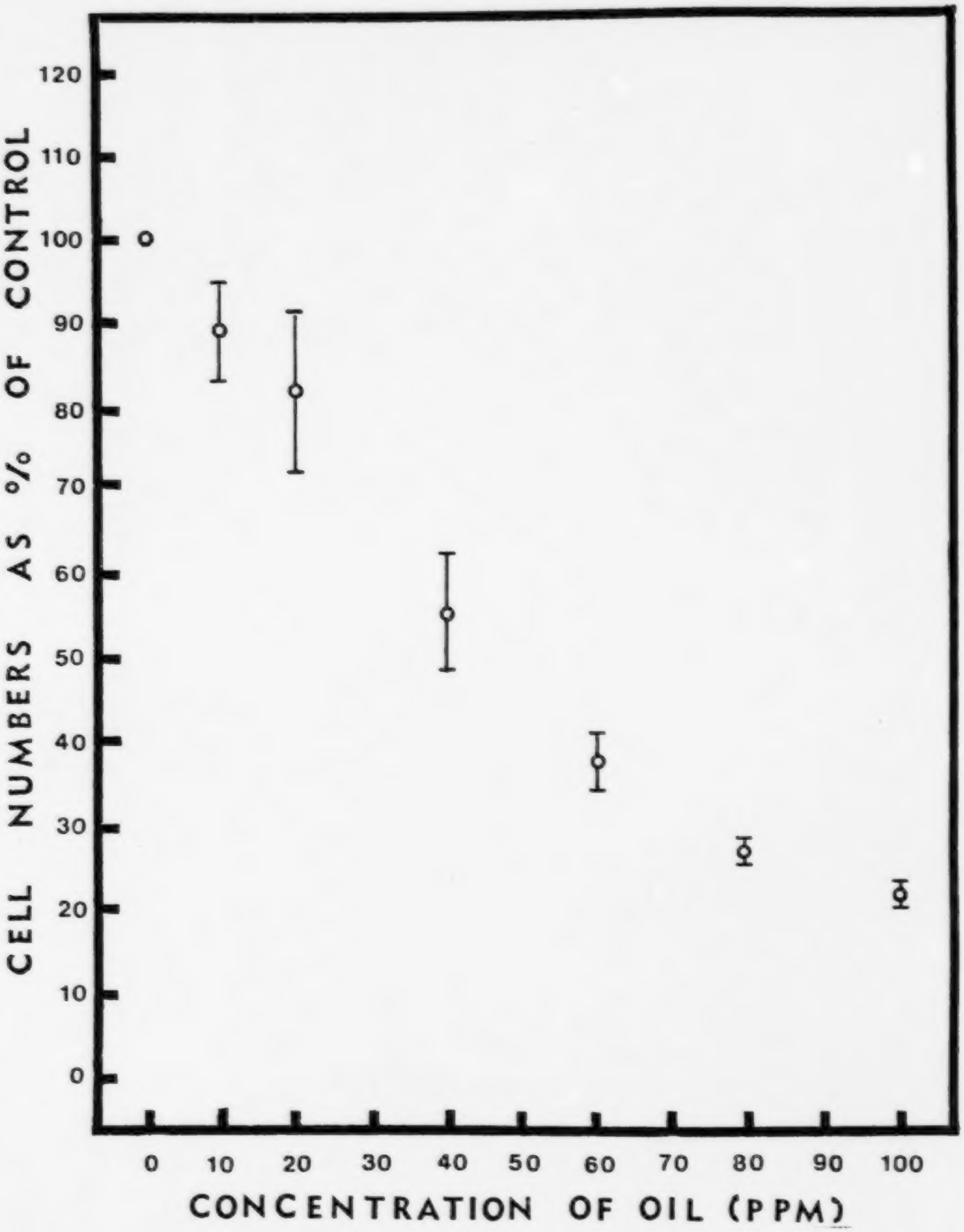
Mean and standard error of cell numbers of Isochrysis galbana expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Saudi Arabian crude oil.



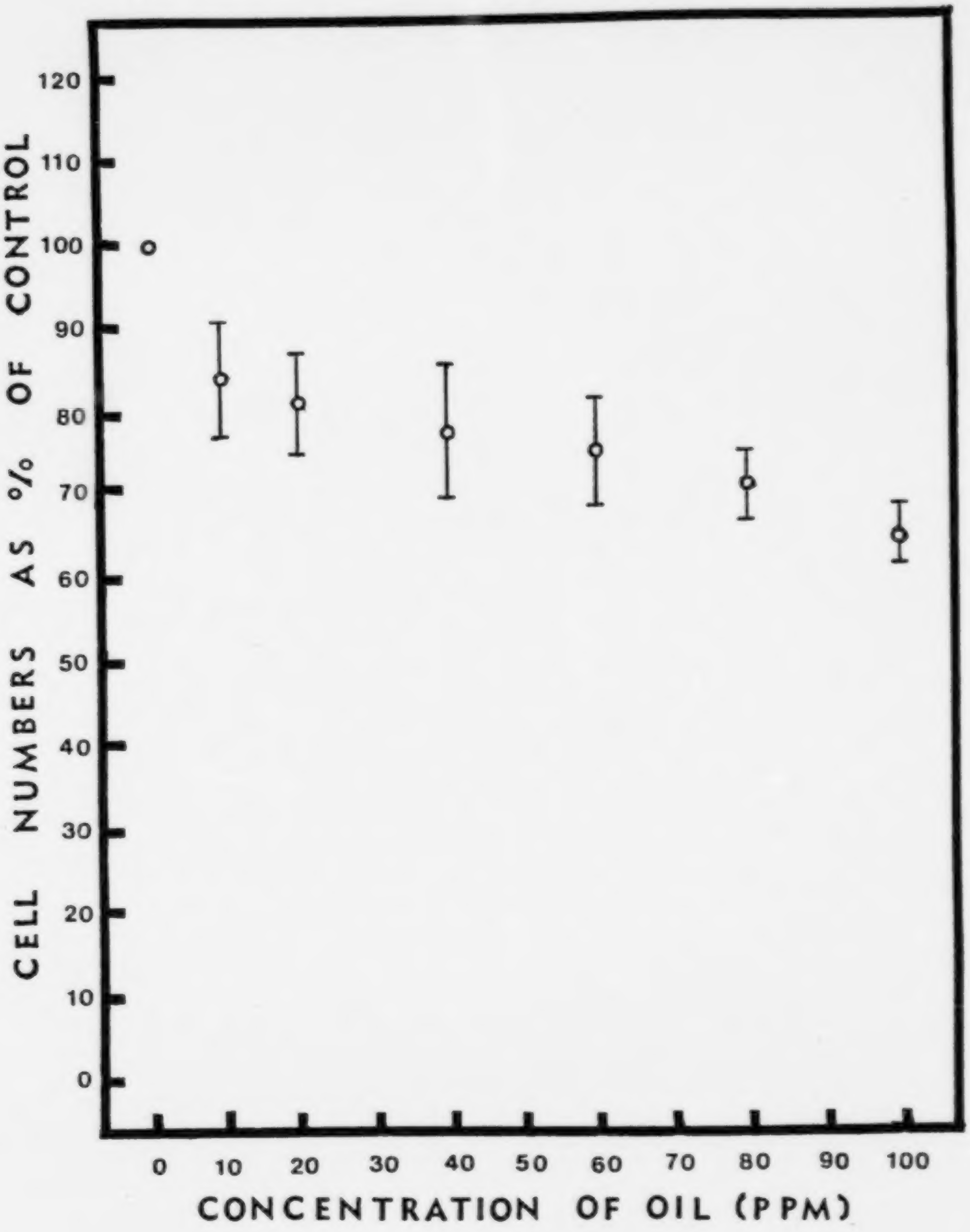
Mean and standard error of cell numbers of *Lithodesmium undulatum* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



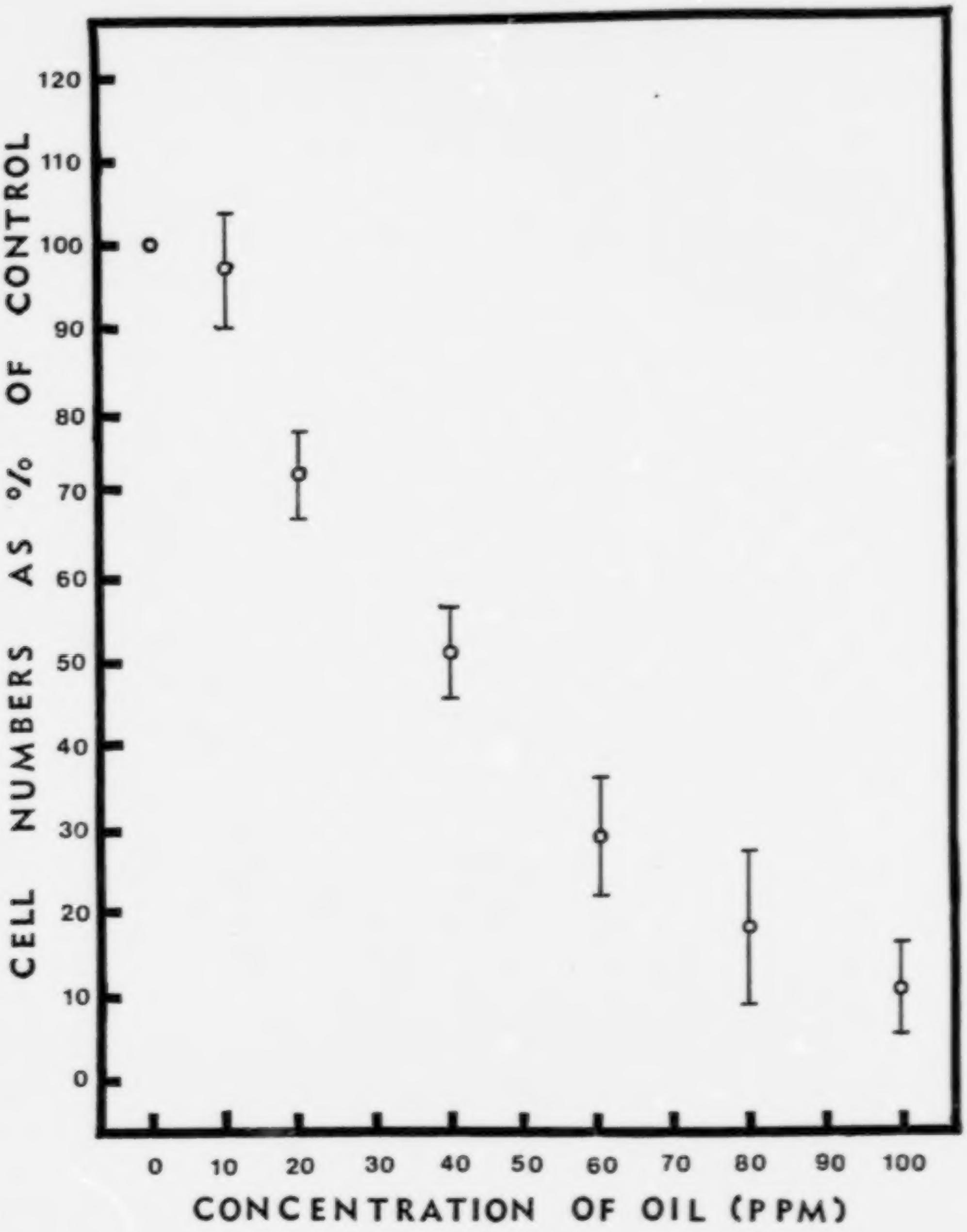
Mean and standard error of cell numbers of Lithodesmium undulatum expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Saudi Arabian crude oil.



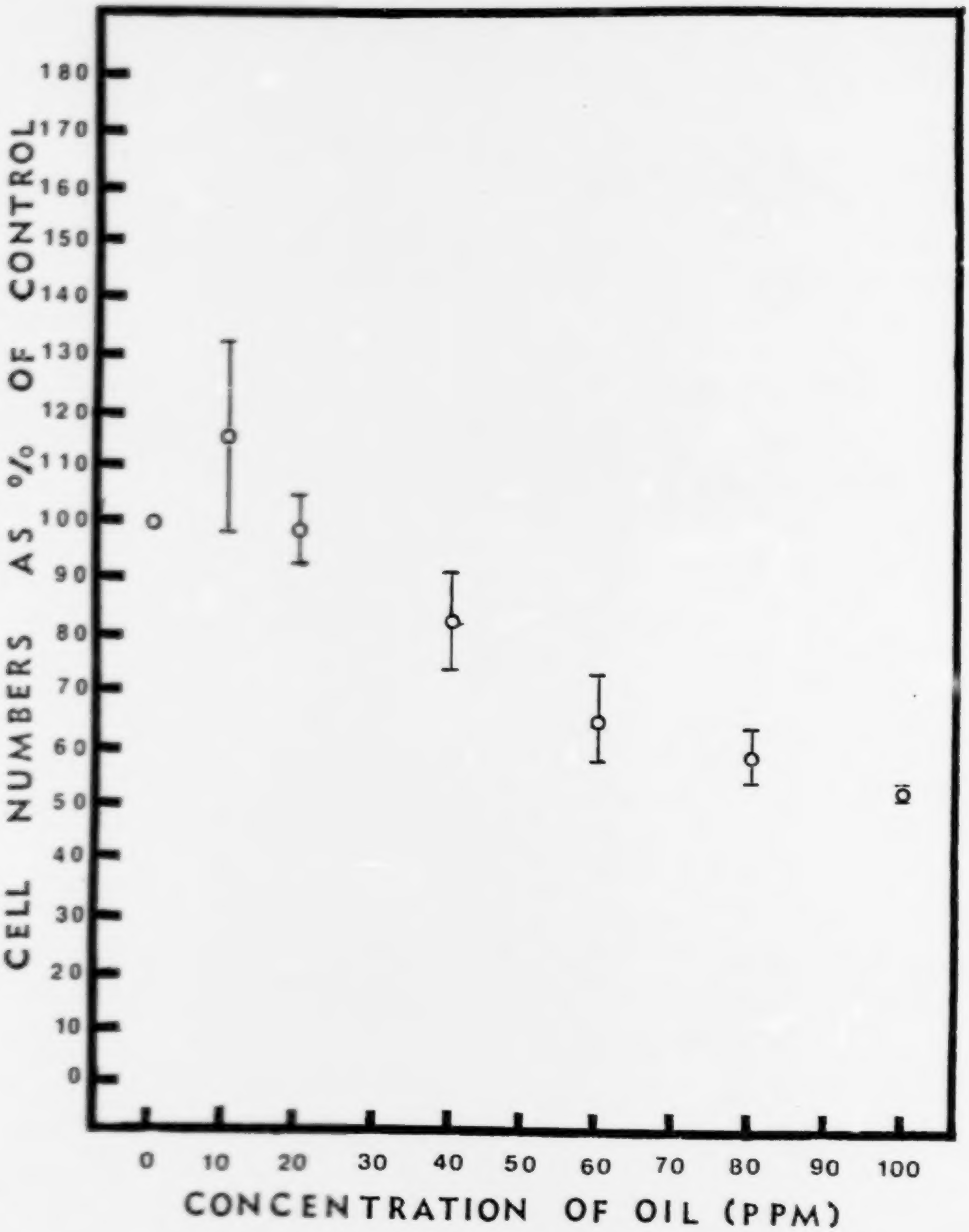
Mean and standard error of cell numbers of Thalassiosira decipiens expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



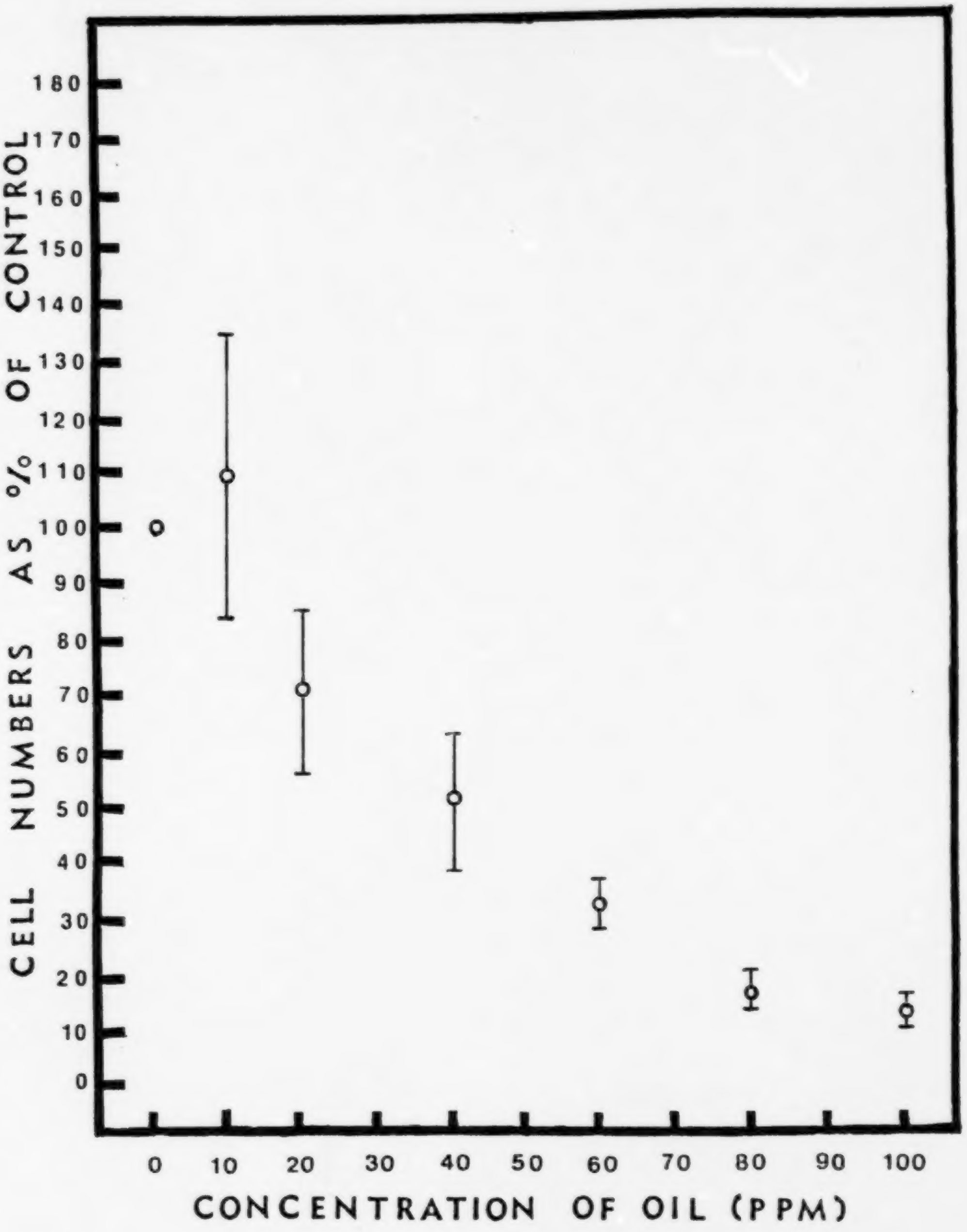
Mean and standard error of cell numbers of _Thalassiosira_ _decipiens_ expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Saudi Arabian crude oil.



Mean and standard error of cell numbers of *Asterionella japonica* expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



Mean and standard error of cell numbers of Carteria chuii expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.



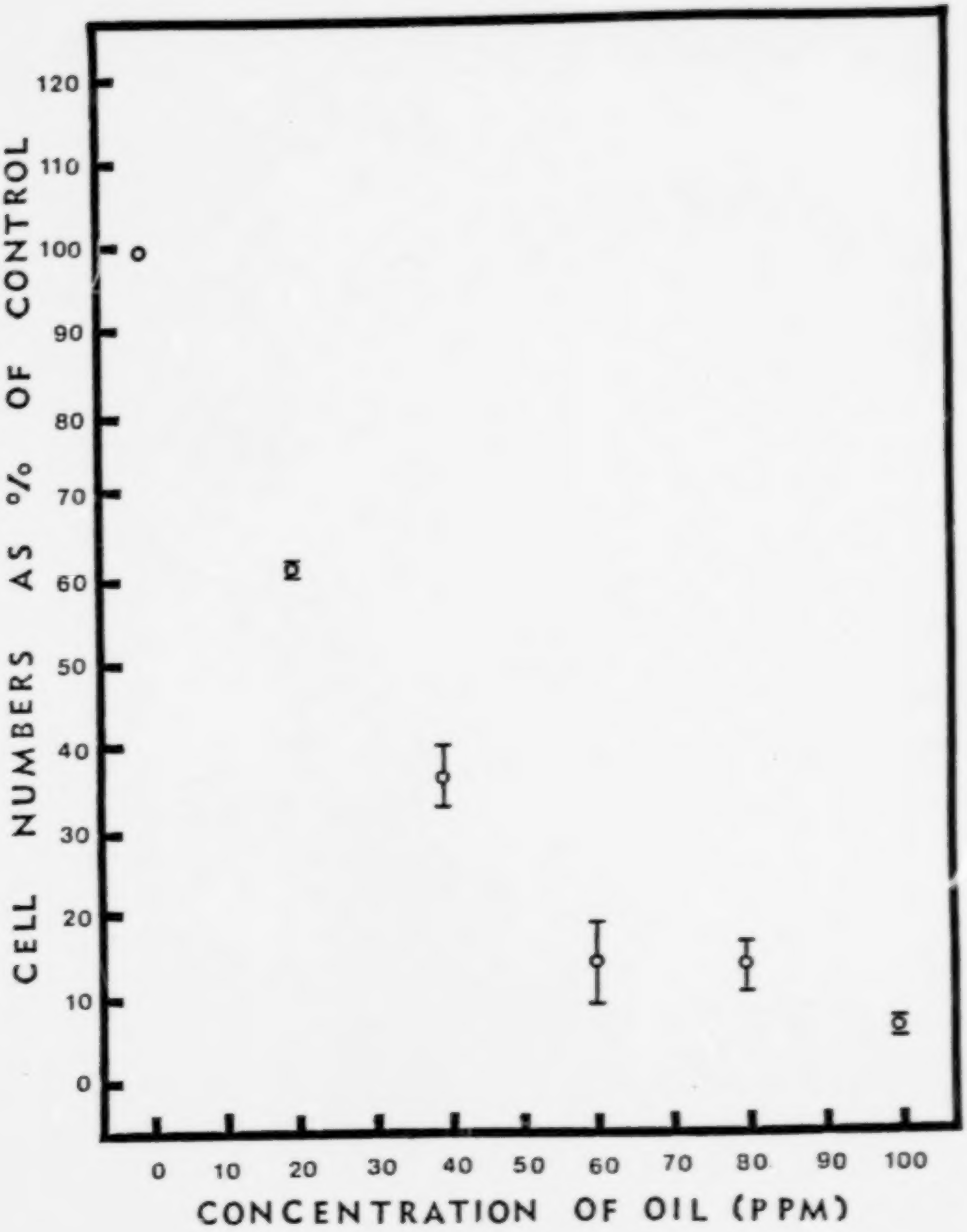
Mean and standard error of cell numbers of Rhizosolenia calcar expressed as percentage of controls after 96 hrs. exposure to 6 concentrations of Empire Mix crude oil.

Item 43

Mean EC_{50} and standard error (SE) of representative species of marine phytoplankton exposed to crude oils for a period of 12 days.

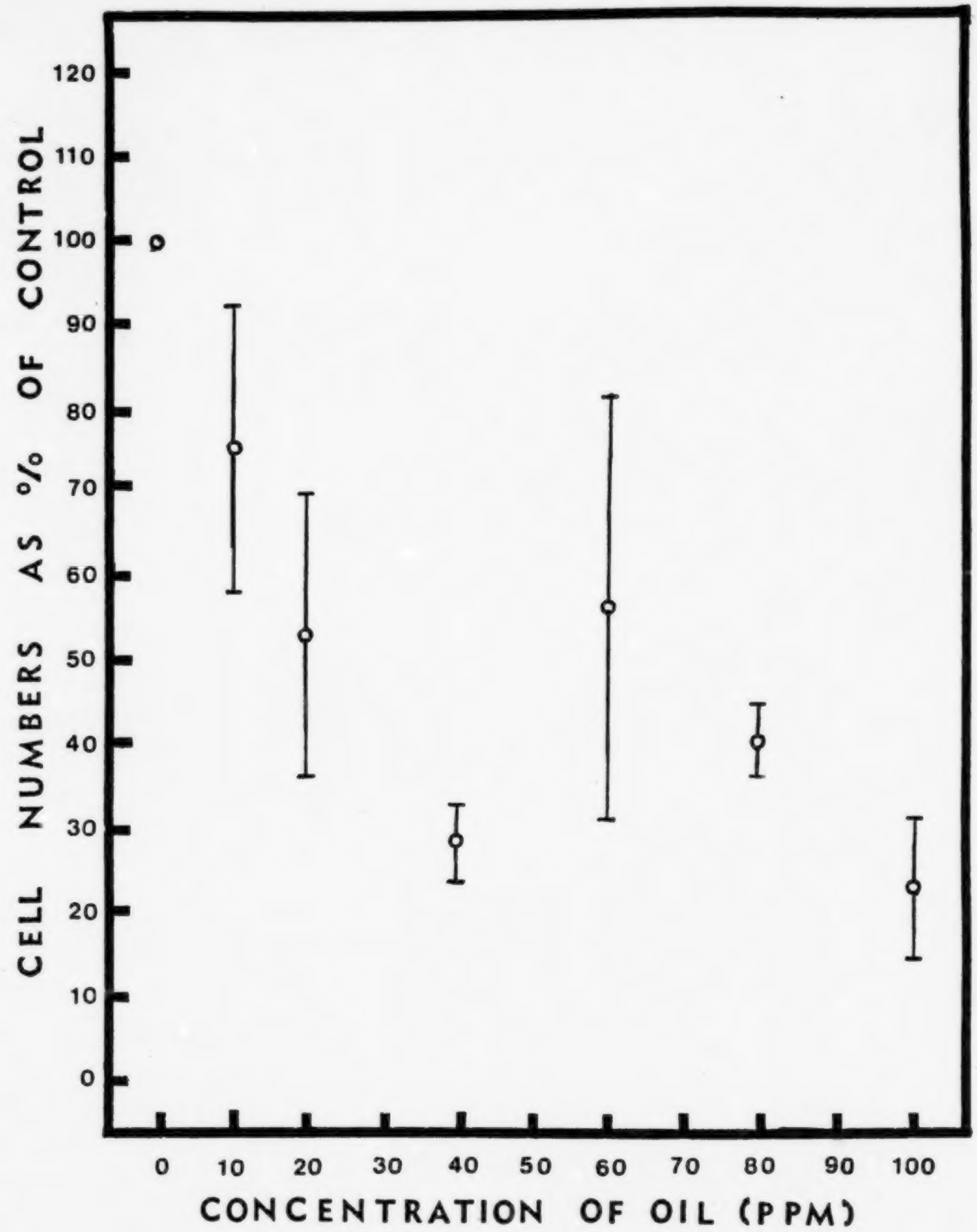
Organism	Oil	EC_{50} (12 Days)	SE
Asterionella japonica	Empire	14.4	1.0
Carteria chuii	Empire	14.4	8.6
Chaetoceros curvisetus	Empire	11.0	0.5
Isochrysis galbana	Empire	12.6	1.1
Lithodesmium undulatum	Empire	9.5	1.1
Skeletonema costatum	Empire	10.6	2.4
Thalassiosira decipiens	Empire	27.7	1.6

Item 44



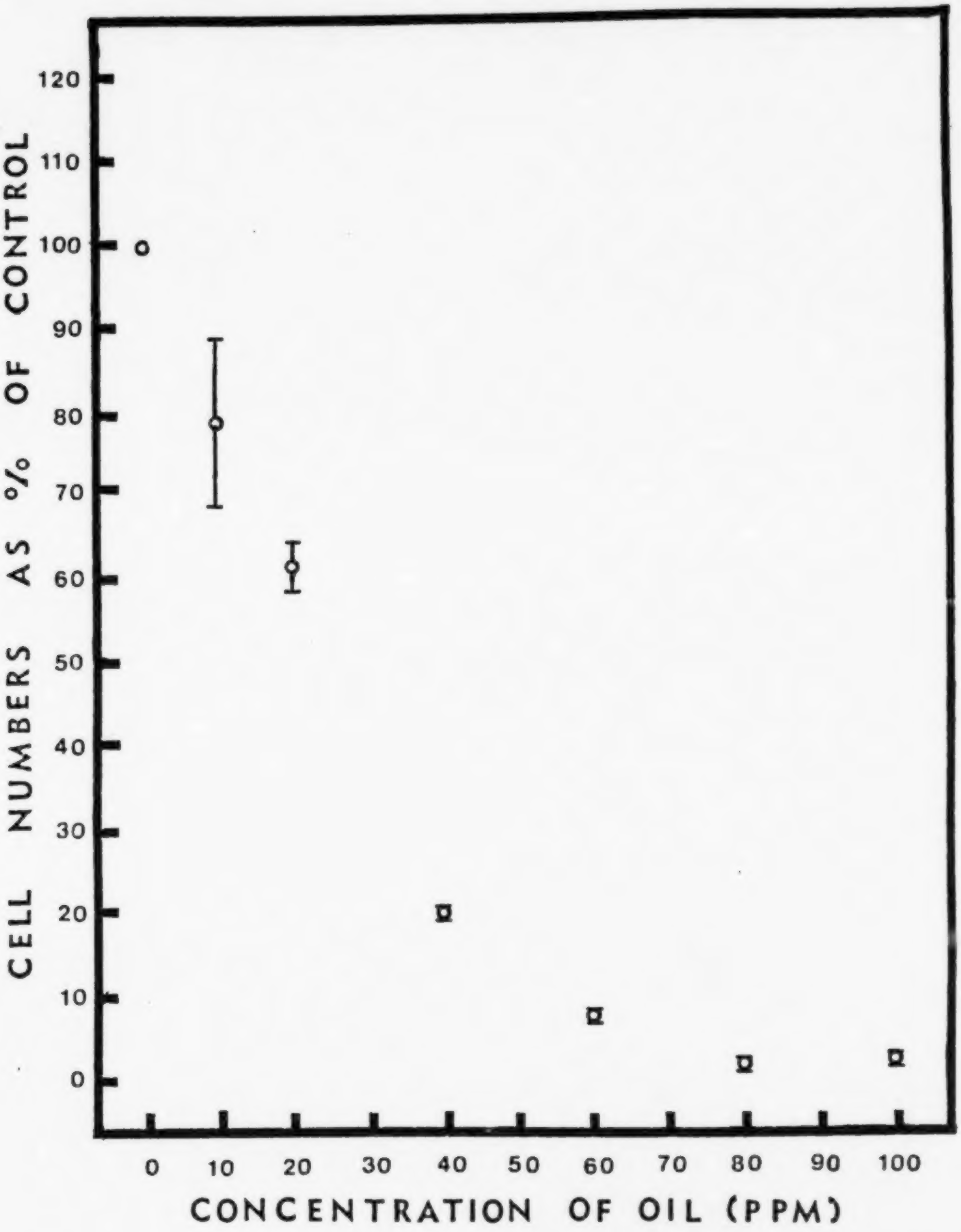
Mean and standard error of cell numbers of Asterionella japonica expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.

Item 45

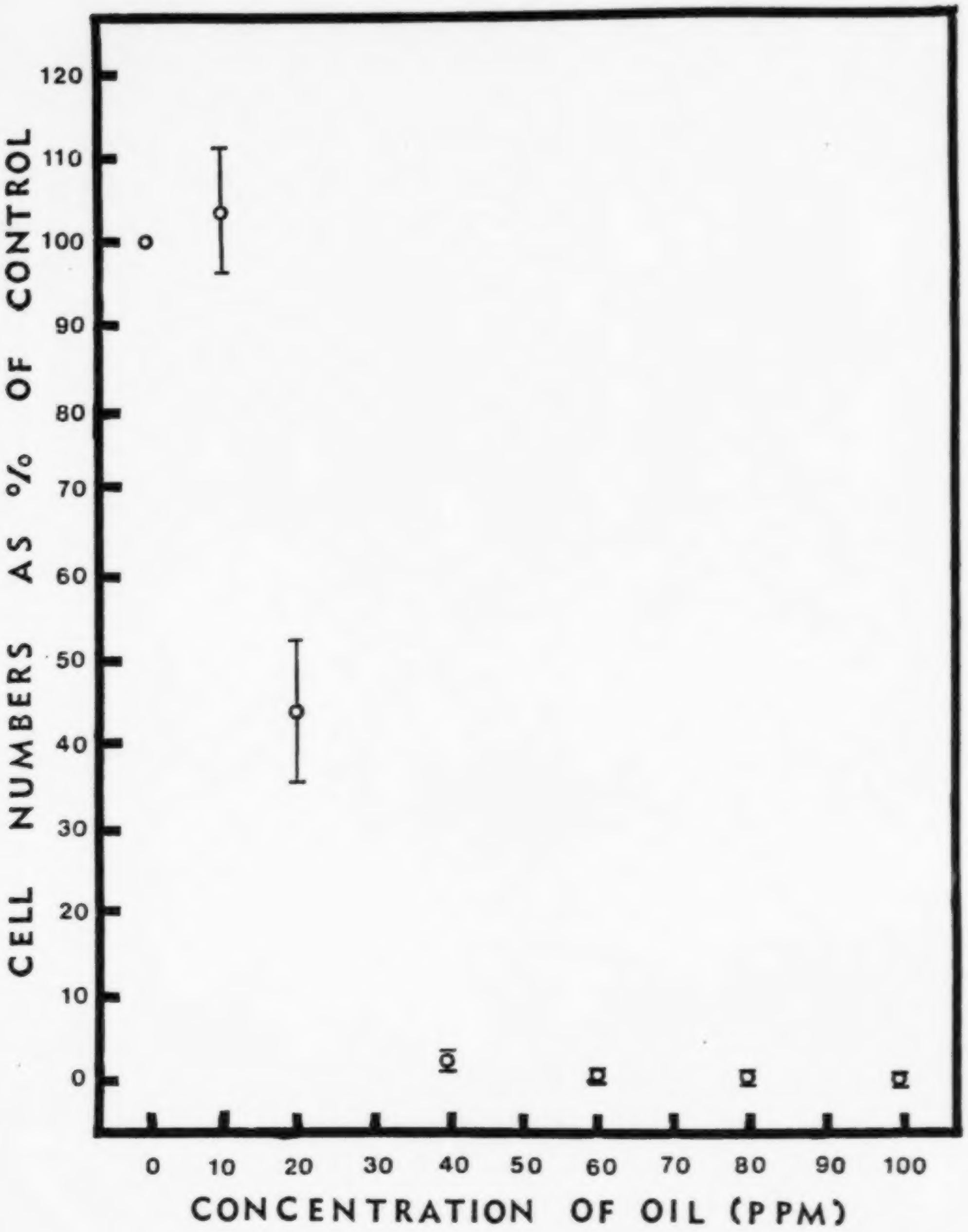


Mean and standard error of cell numbers of Carteria chuii expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.

Item 46

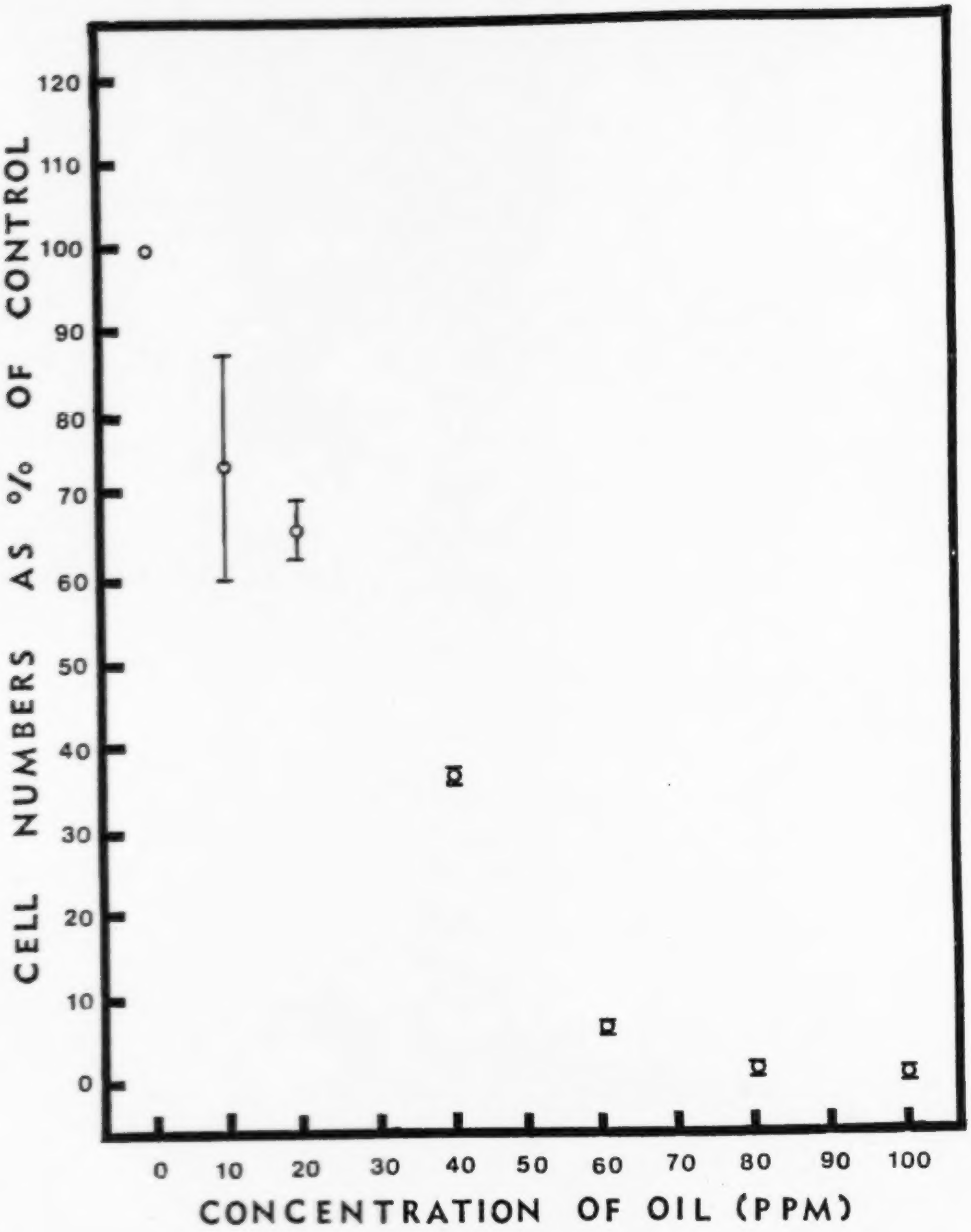


Mean and standard error of cell numbers of Chaetoceros curvisetus expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.

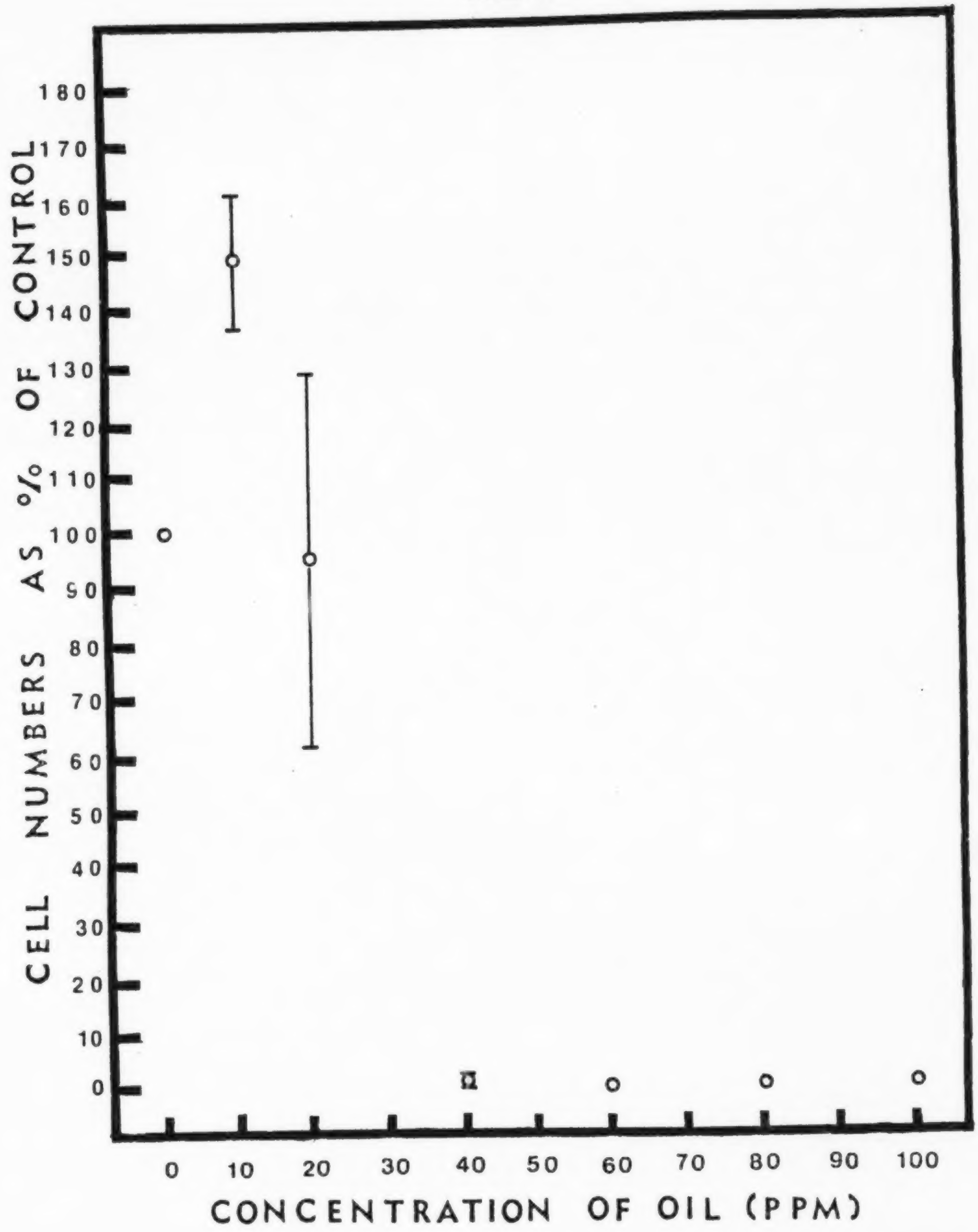


Mean and standard error of cell numbers of Lithodesmium undulatum expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.

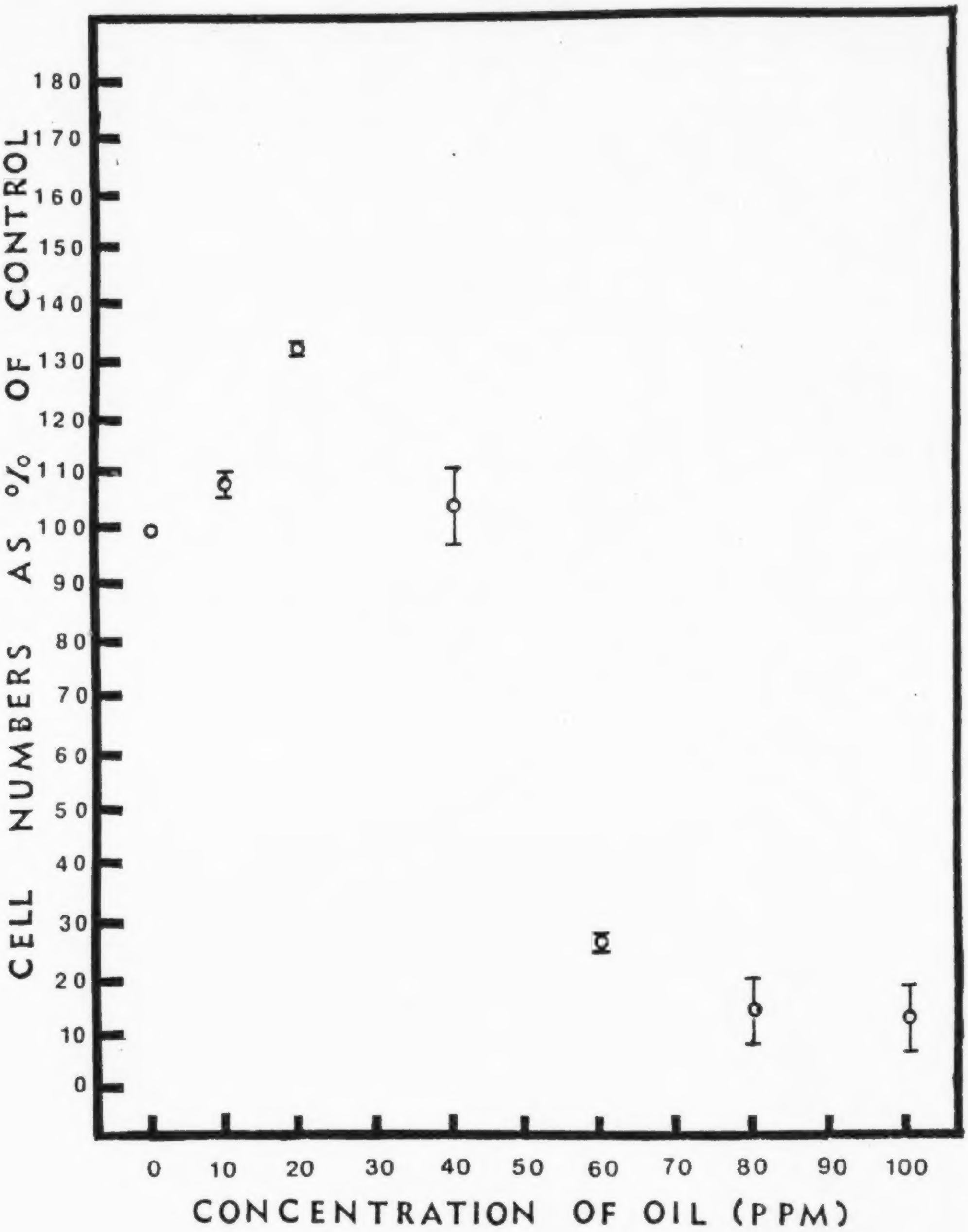
Item 48



Mean and standard error of cell numbers of Isochrysis galbana expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.



Mean and standard error of cell numbers of Skeletonema costatum expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.



Mean and standard error of cell numbers of Thalassiosira decipiens expressed as percentage of controls after 12 days exposure to 6 concentrations of Empire Mix crude oil.

Item 51

Chronic effects of Empire Mix (EC), Saudi Arabian (SC), Iranian (IC), Nigerian (NC), and Venezuelan (VC) crude oils on select species of phytoplankton.

Organism	Oil	Exposure (Hours)	Fresh Medium (Days)	Recovery from Acute Exposure (PPM)
Chaetoceros curvisetus	EC	96 ± 3	167	0-100
Chaetoceros curvisetus	S	96 ± 3	141	0-100
Isochrysis galbana	S	12 days	162	0-100
Skeletonema costatum	EC	96 ± 3	167	0-100
Skeletonema costatum	IC	96 ± 3	93	0-100
Skeletonema costatum	IC	96 ± 3	97	0,20,40,80,100
Skeletonema costatum	S	96 ± 3	141	0,40,80
Skeletonema costatum	NC	96 ± 3	95	0-100
Skeletonema costatum	NC	96 ± 3	53	0-100
Skeletonema costatum	VC	96 ± 3	94	0-100
Skeletonema costatum	VC	96 ± 3	107	0-100
Thalassiosira decipiens	EC	96 ± 3	167	0-100
Thalassiosira decipiens	S	96 ± 3	141	0-100
Thalassiosira decipiens	S	12 days	169	0-100

Item 52

Levels of oil found by liquid chromatography (LC) and gas chromatography (GC) to be present in 7 representative species of marine phytoplankton* grown in medium treated with Empire Mix.

Organism	Exposure** Period (days)	LC Experimental (μg)	LC Control (μg)	GC Experimental (μg)	GC Control (μg)
Asterionella japonica	18	152	0	34	11
Carteria chuii	13	270	257	305	44
	20	1529	0	14	0
Chaetoceros curvisetus	7	1353	294	1	0
	7	4338	2305	59	0
	7	4552	1037	163	0
	7	2434	727	195	0
Isochrysis galbana	8	21904	1693	2960	0
	20	8647	2294	38	4
Lithodesmium undulatum	7	1718	952	15	0
	7	4568	87	3607	0
Skeletonema costatum	23	922	411	35	0
	7	9210	0	503	0
Thalassiosira decipiens	10	7684	796	1917	0
	7	9735	1600	269	0
	7	7271	0	900	0

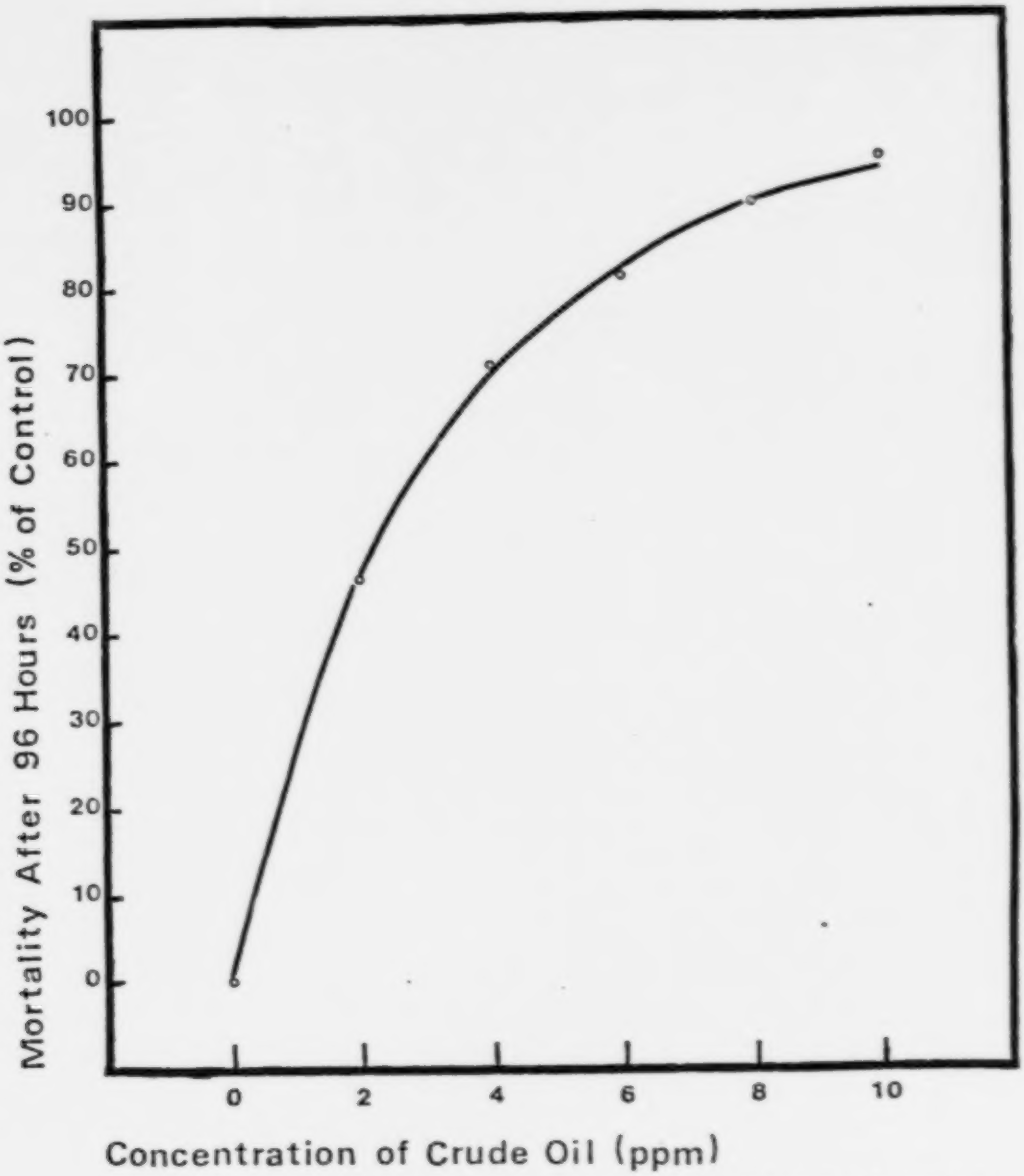
*Grown in inverted, aerated 4-liter serum bottles containing 3 l of Heinle growth medium.

**Exposure level = 13,920 μg

Item 53

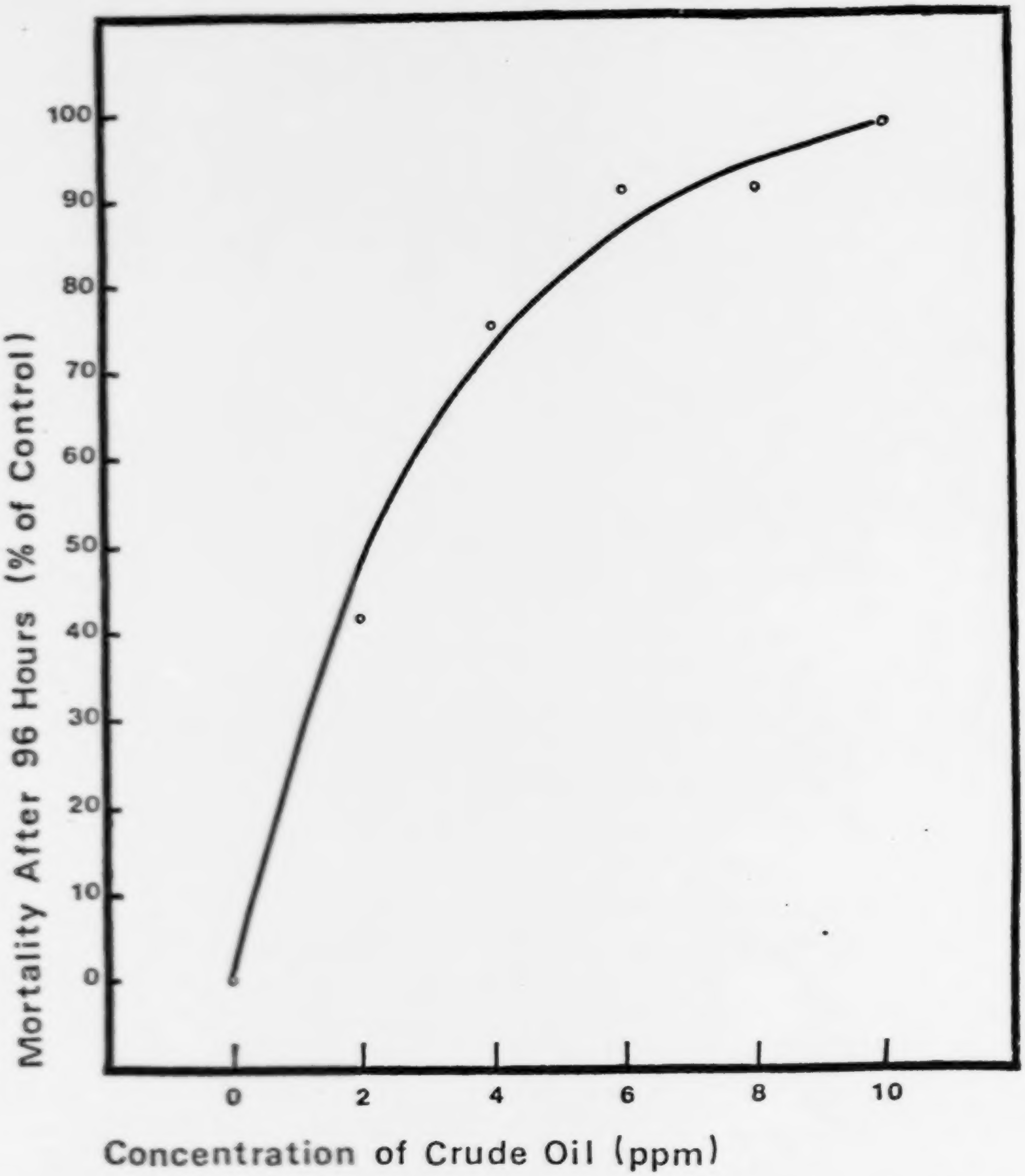
TL_{50} values obtained from copepod bioassays

Crude Oil	*A. tonsa*	*E. acutifrons*	*C. viridis*	*E. affinis*
Empire Mix	1.1	79.2	Undefined	7.8
Iranian	1.2	124.4	Undefined	
Nigerian	0.6	35.2	27.1	
Saudi Arabian	0.9	104.7	Undefined	
Venezuelan	1.6	151.9	Undefined	

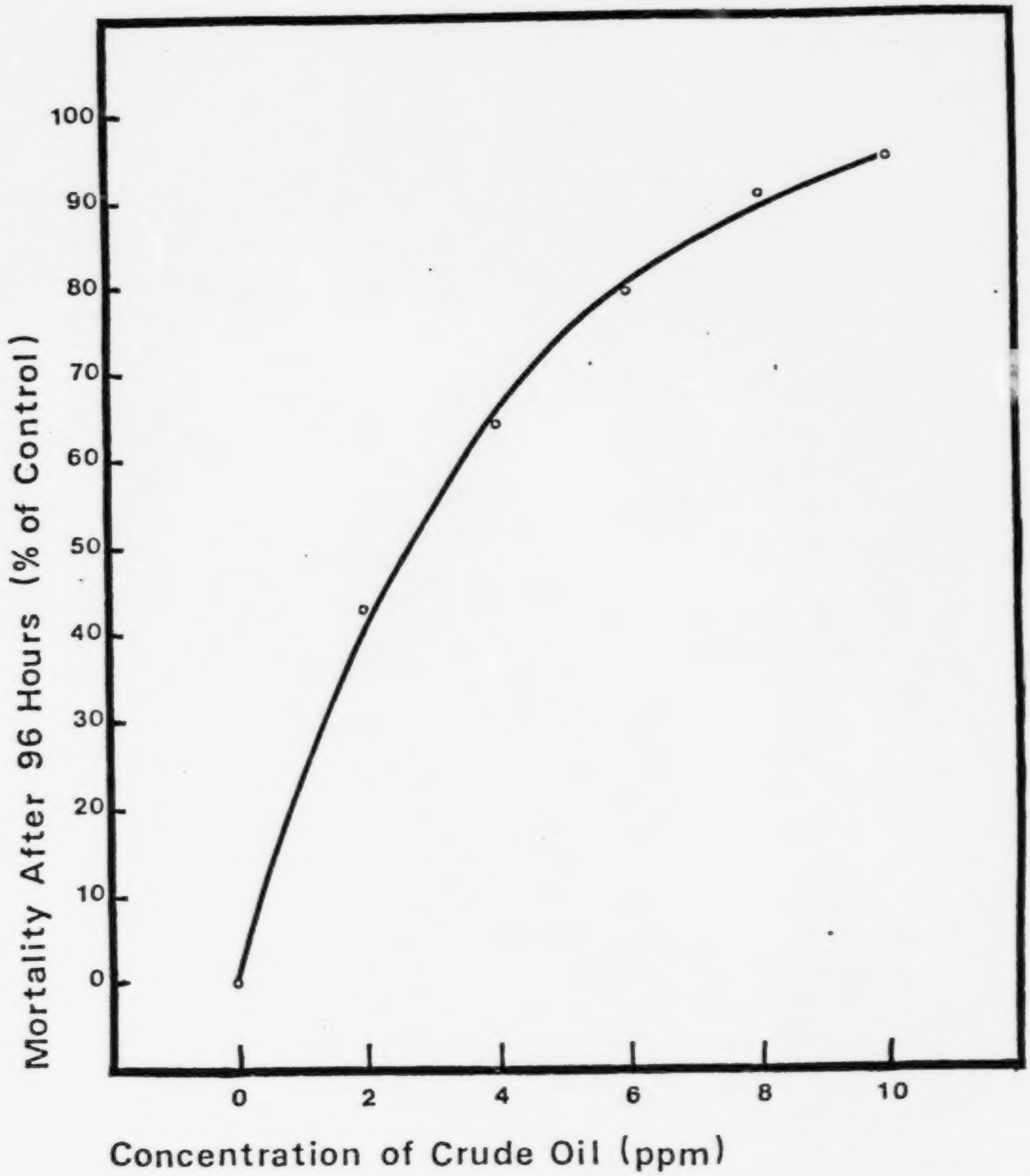


Asymptotic regression of means of population response of laboratory reared *Acartia tonsa* to concentrations of Empire Mix Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 2.25 ppm calculated value (1.1 ppm actual).

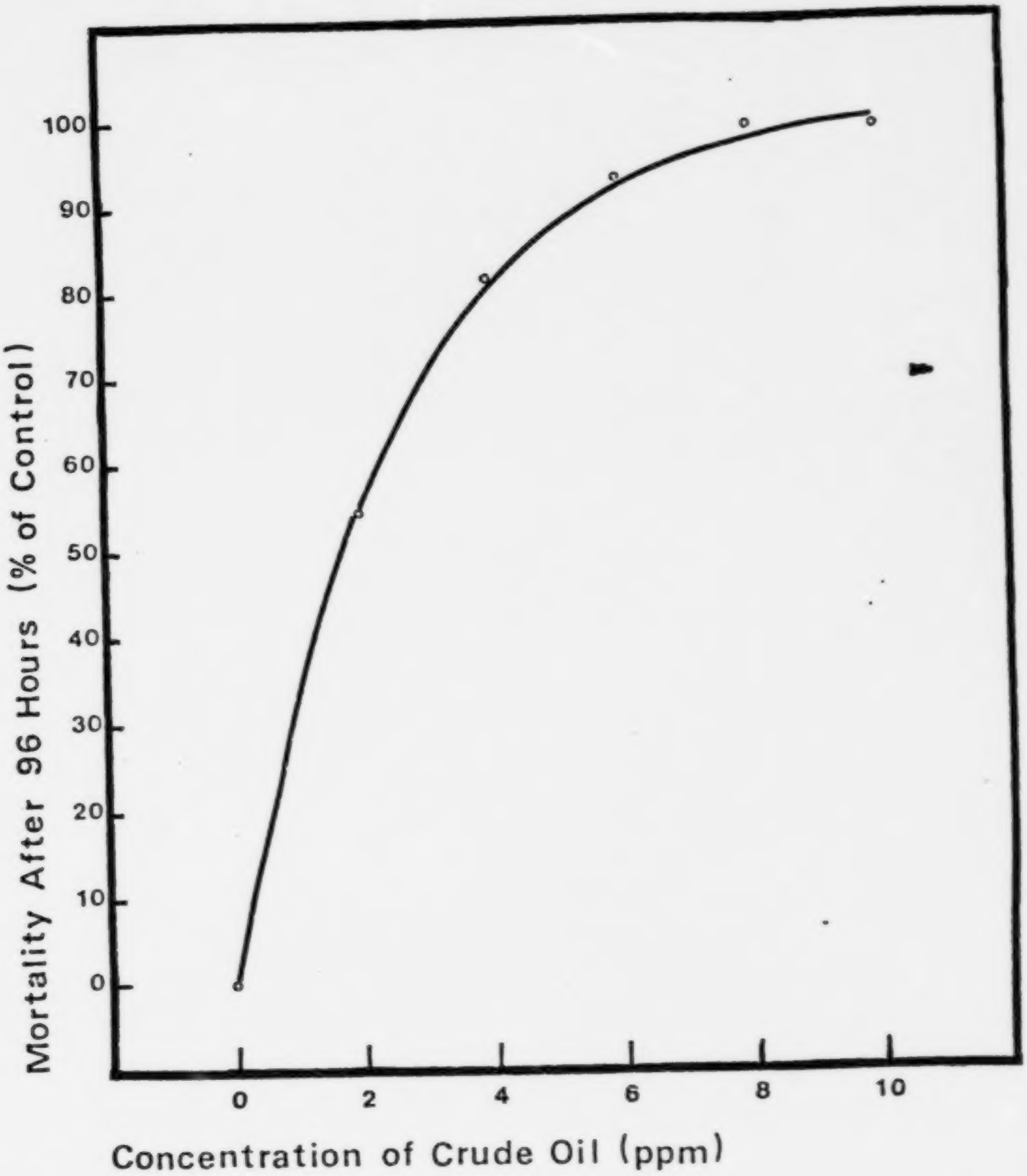
Item 55



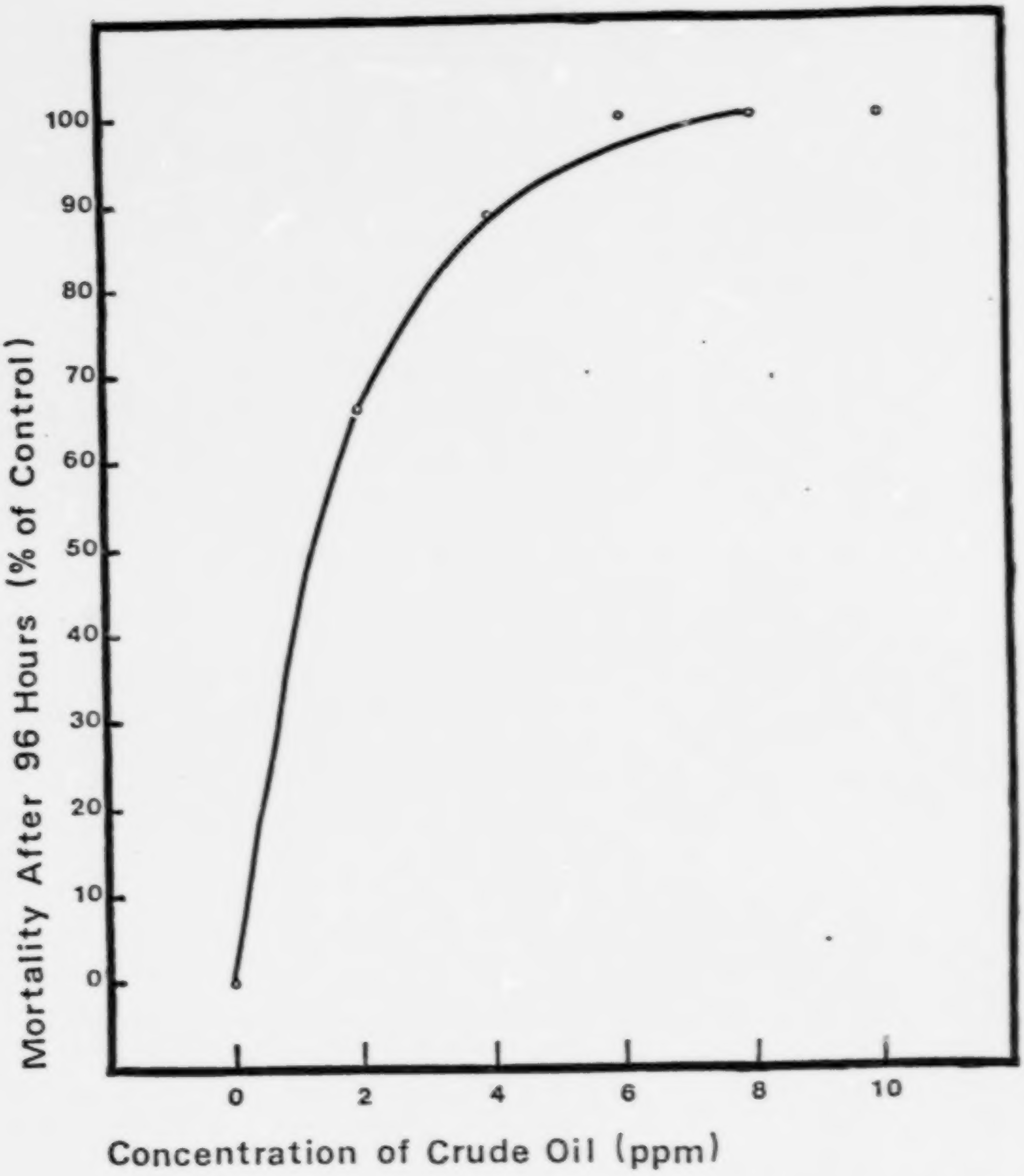
Asymptotic regression of means of population response of laboratory reared Acartia tonsa to concentrations of Iranian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 2.2 ppm calculated value (1.2 ppm actual).



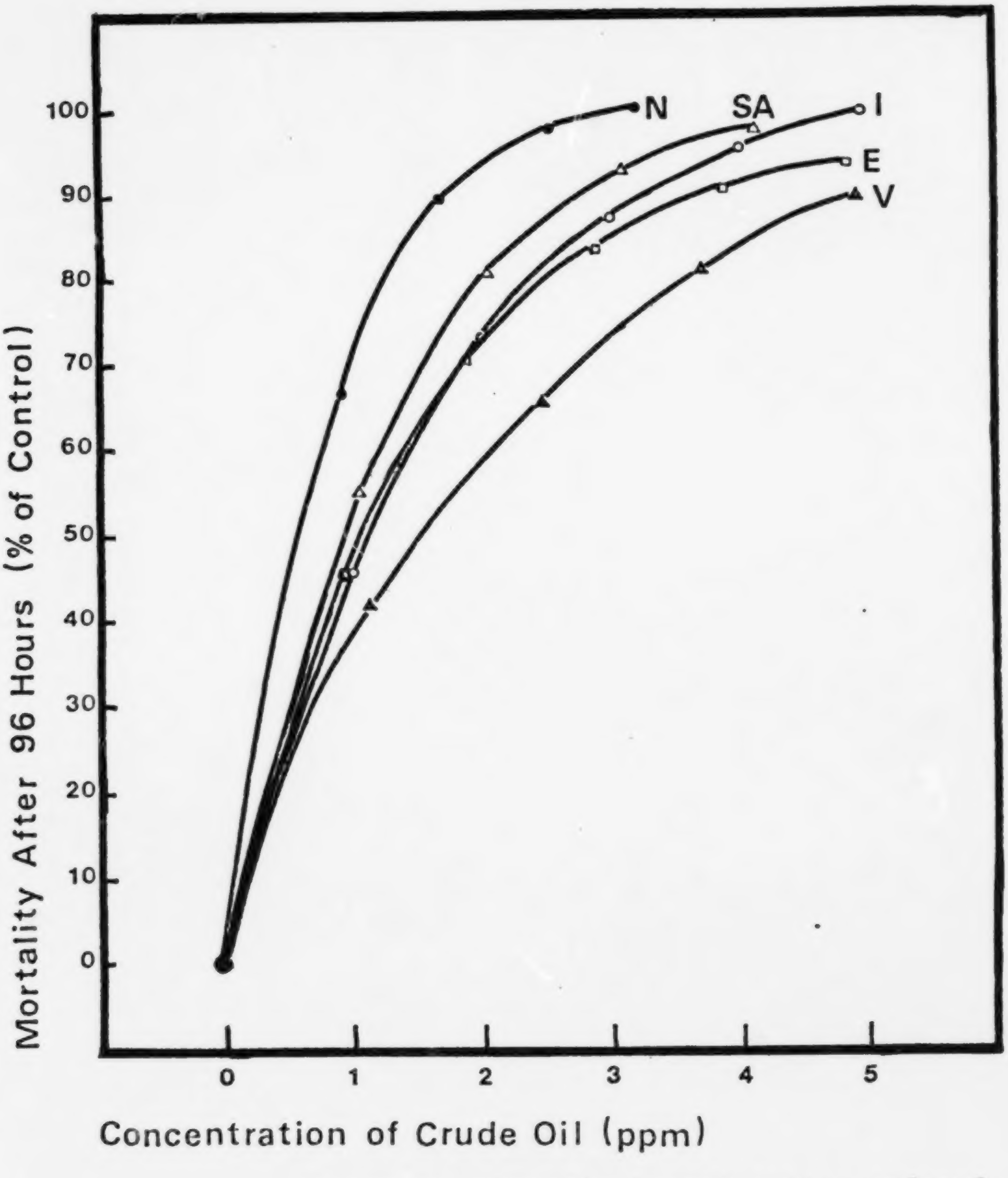
Asymptotic regression of means of population response of laboratory reared Acartia tonsa to concentrations of Venezuelan Crude Oil after 96 hour exposure. Based on 6 replicates, suplicate samples for each replicate. TL_{50} = 2.6 ppm calculated value (1.6 ppm actual).



Asymptotic regression of means of population response of laboratory reared Acartia tonsa to concentrations of Saudi Arabian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 1.7 ppm calculated value (0.9 ppm actual).

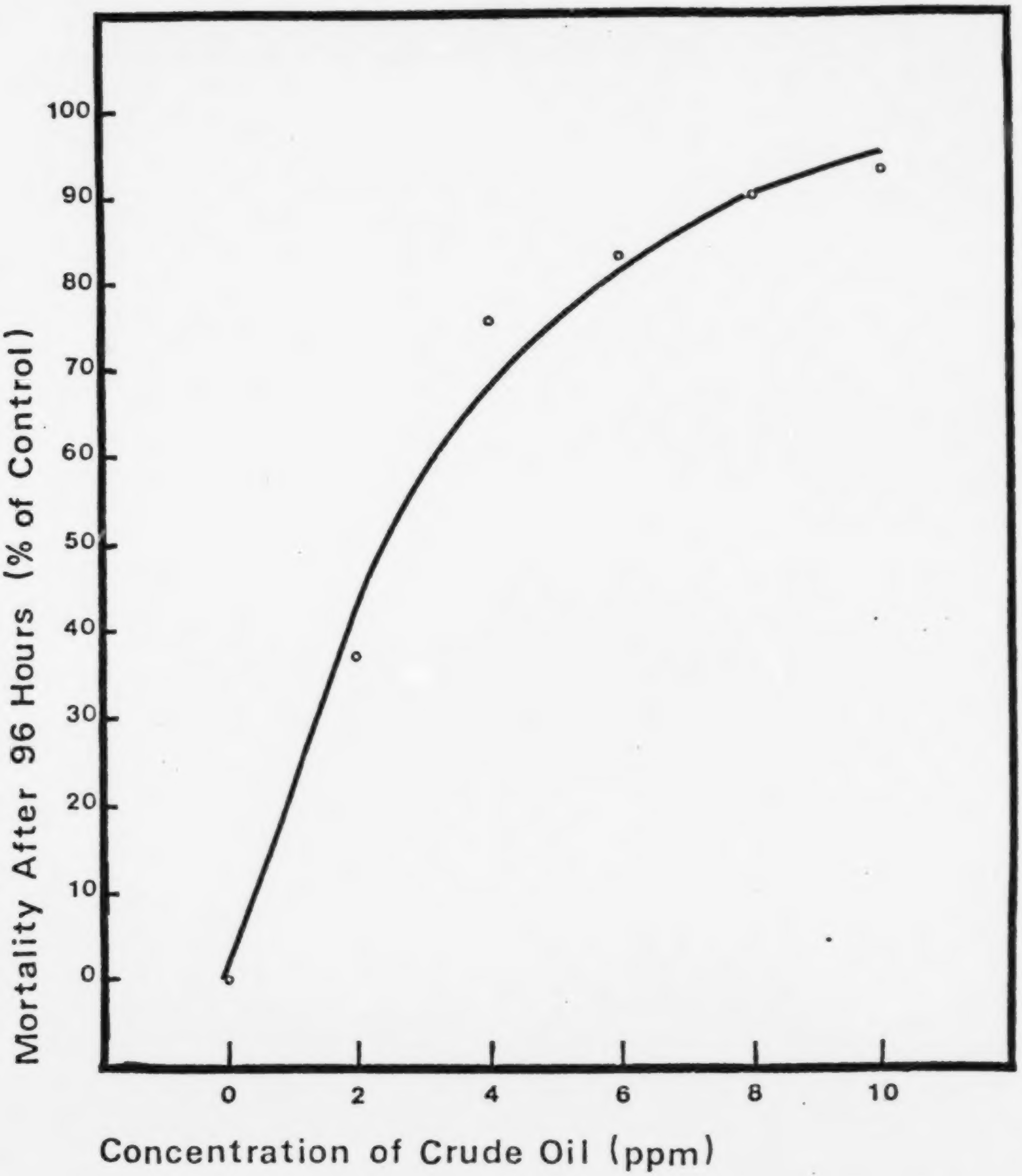


Asymptotic regression of means of population response of laboratory reared Acartia tonsa to concentrations of Nigerian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 1.3 ppm calculated value (0.6 ppm actual).

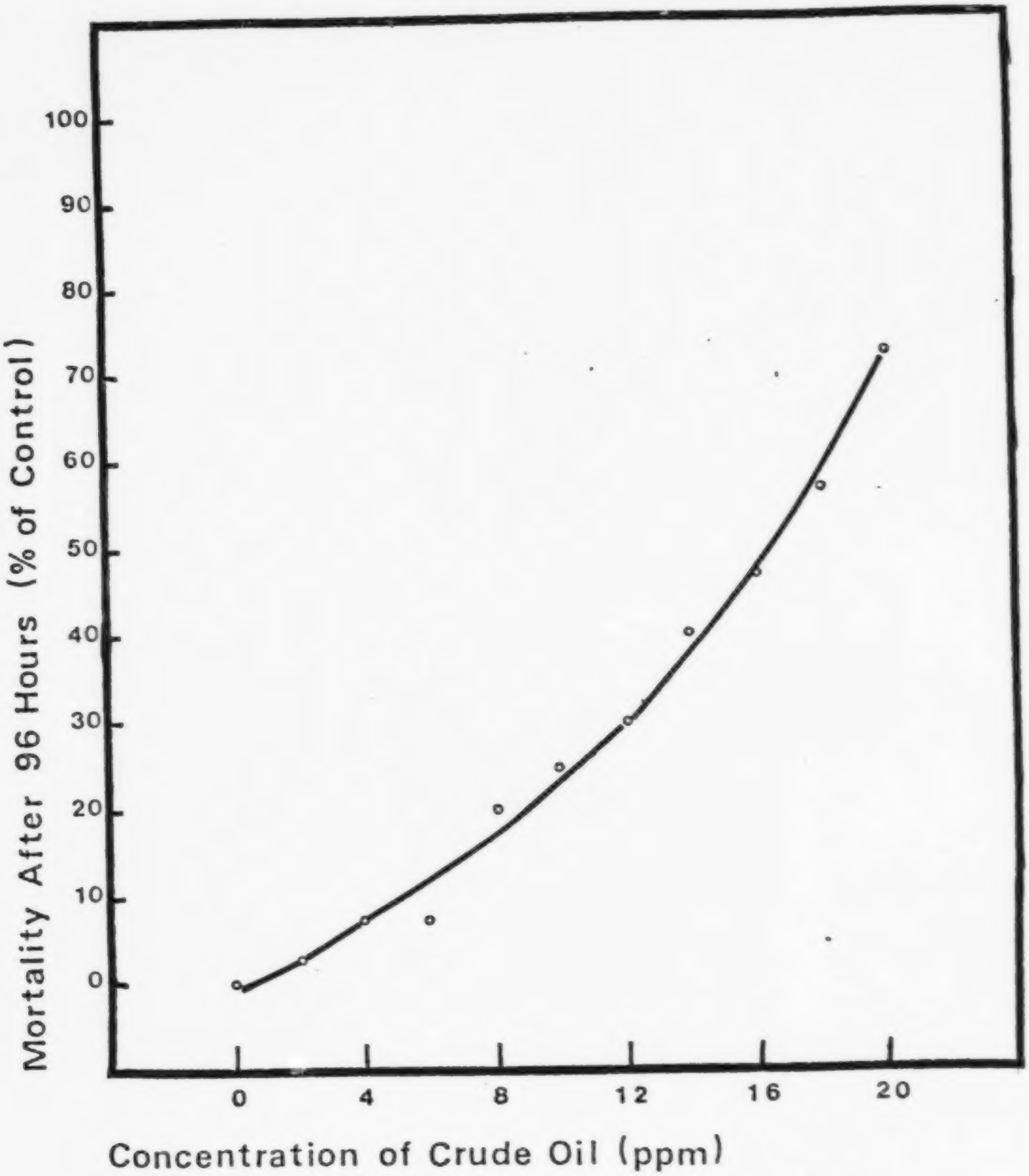


Response curve for Acartia tonsa reduced by their percent emulsion valves to common scales to compare toxicities of oil. Crude oils used were: Empire Mix (□——□), Iranian (○——○), Nigerian (●——●), Saudi Arabian (△——△), and Venezuelan (▲——▲).

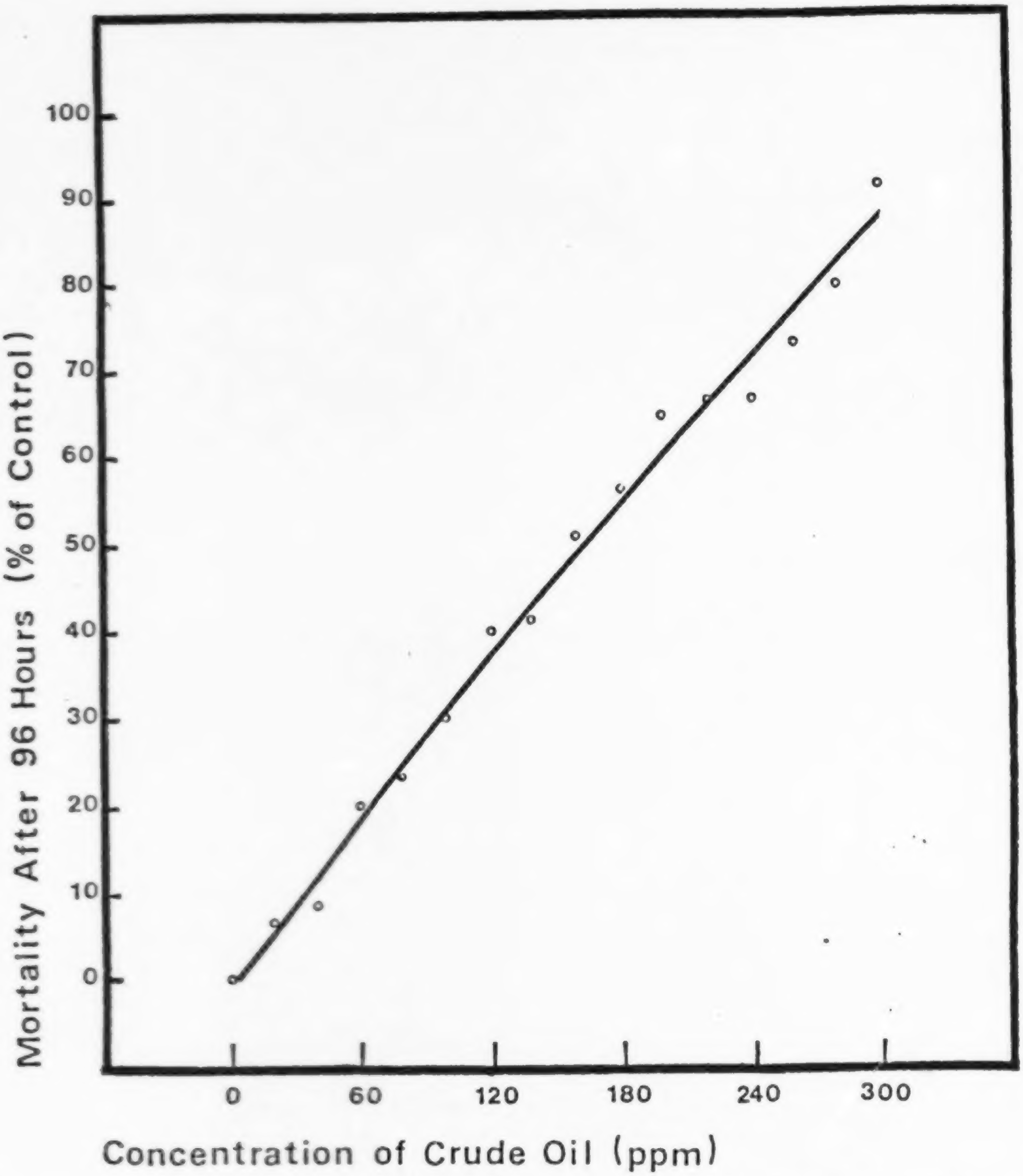
Item 60



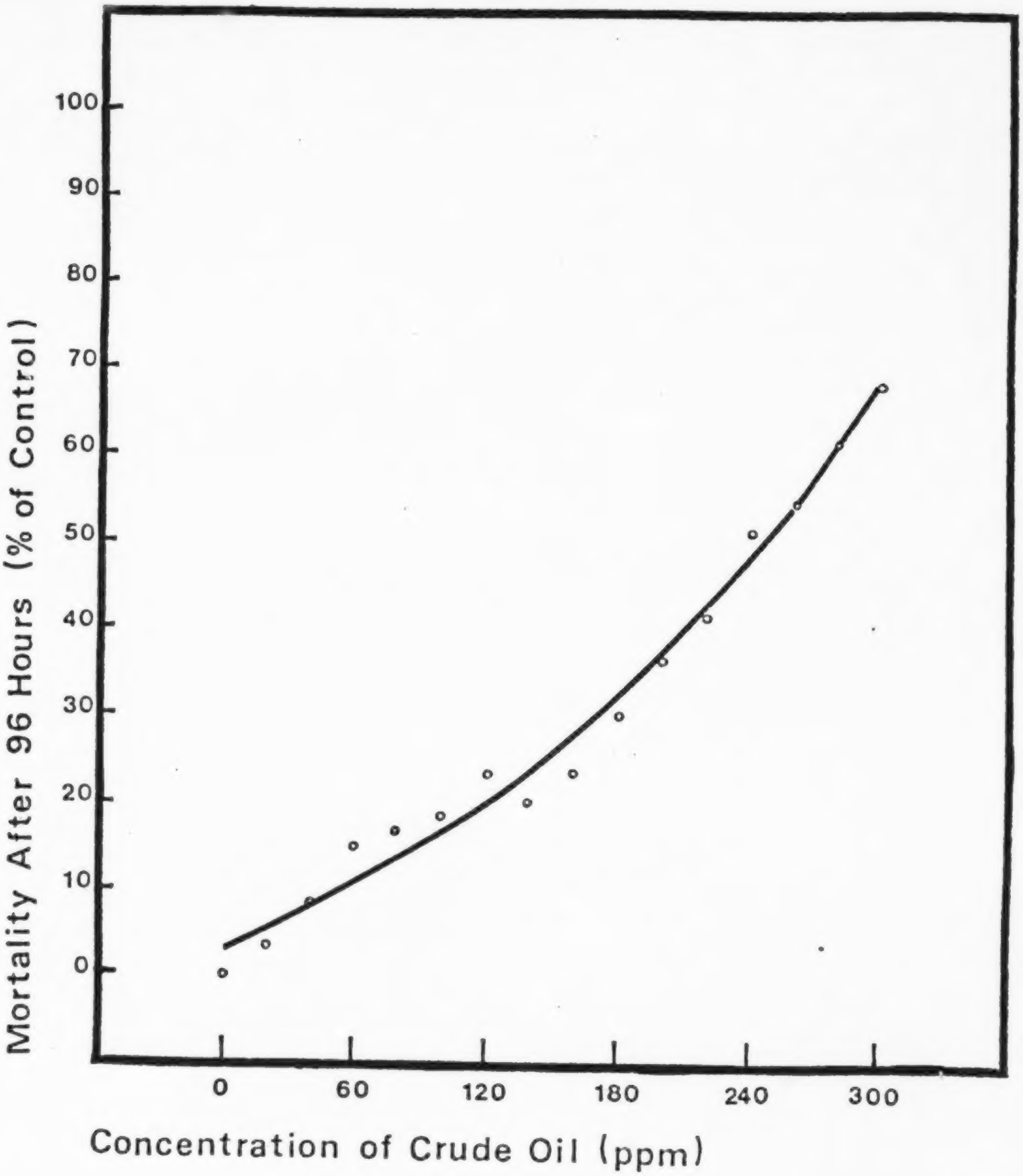
Asymptotic regression of means of population response of pond *Acartia tonsa* to concentrations of Empire Mix Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 2.4 calculated value (1.2 ppm actual).



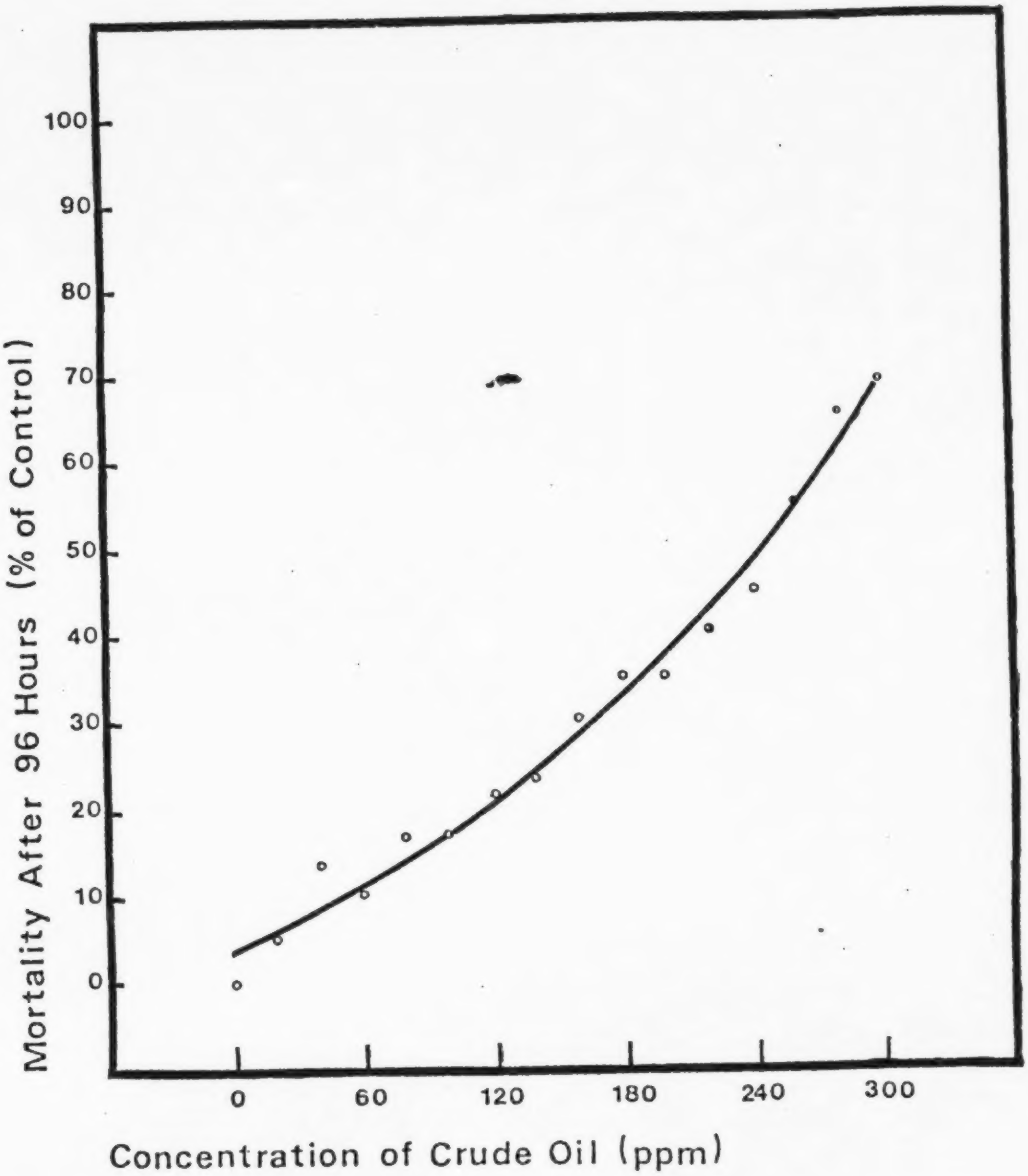
Asymptotic regression of means of population response of _Eurytemora affinis_ to concentrations of Empire Mix Crude Oil after 96 hour exposure. Based on 4 replicates, duplicate samples for each replicate. TL_{50} = 16.3 ppm calculated value (7.8 ppm actual).



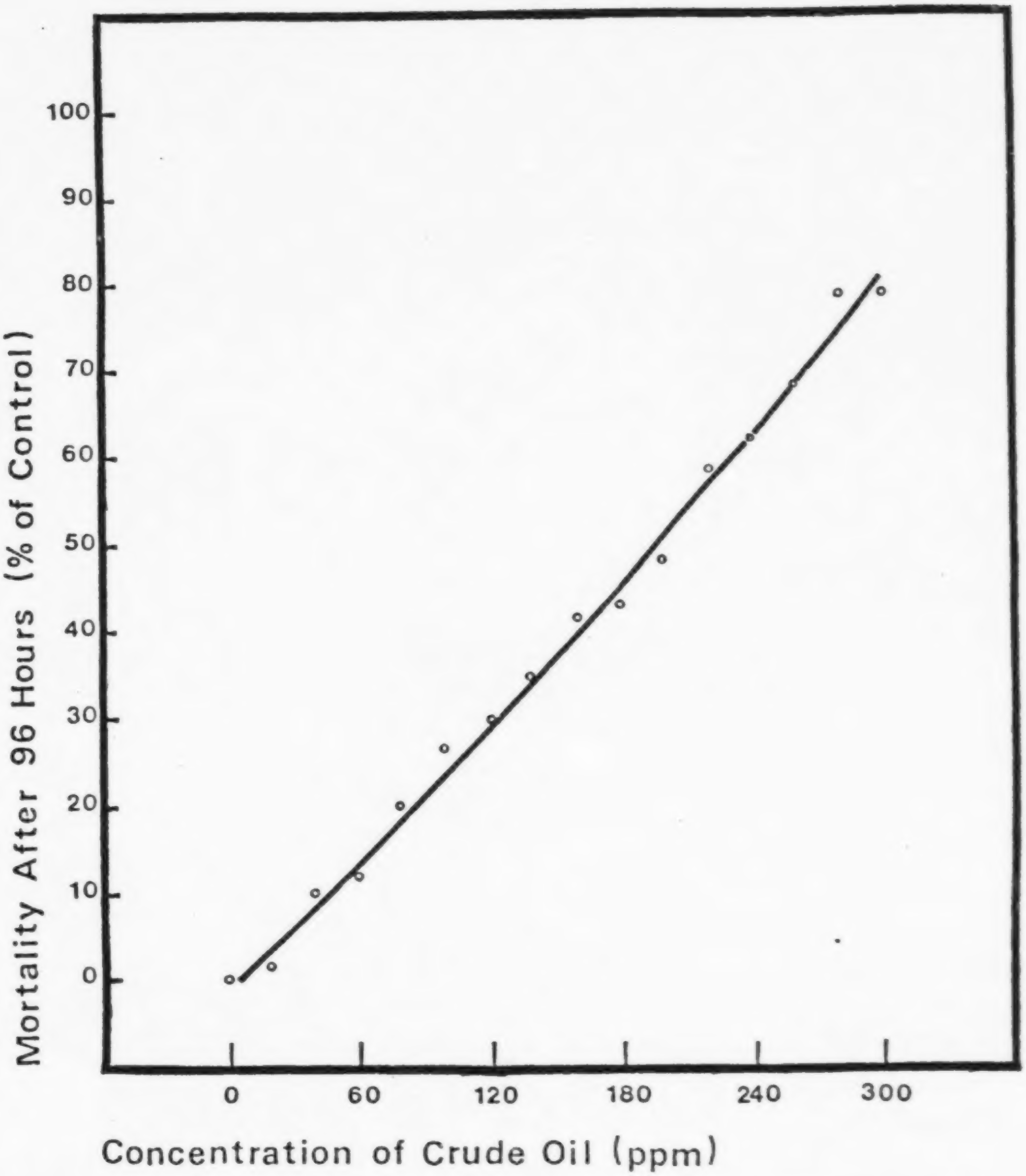
Asymptotic regression of means of population response of [illegible]terpina acutifrons to concentrations of Empire Mix Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 165.1 ppm calculated value (79.2 ppm actual).



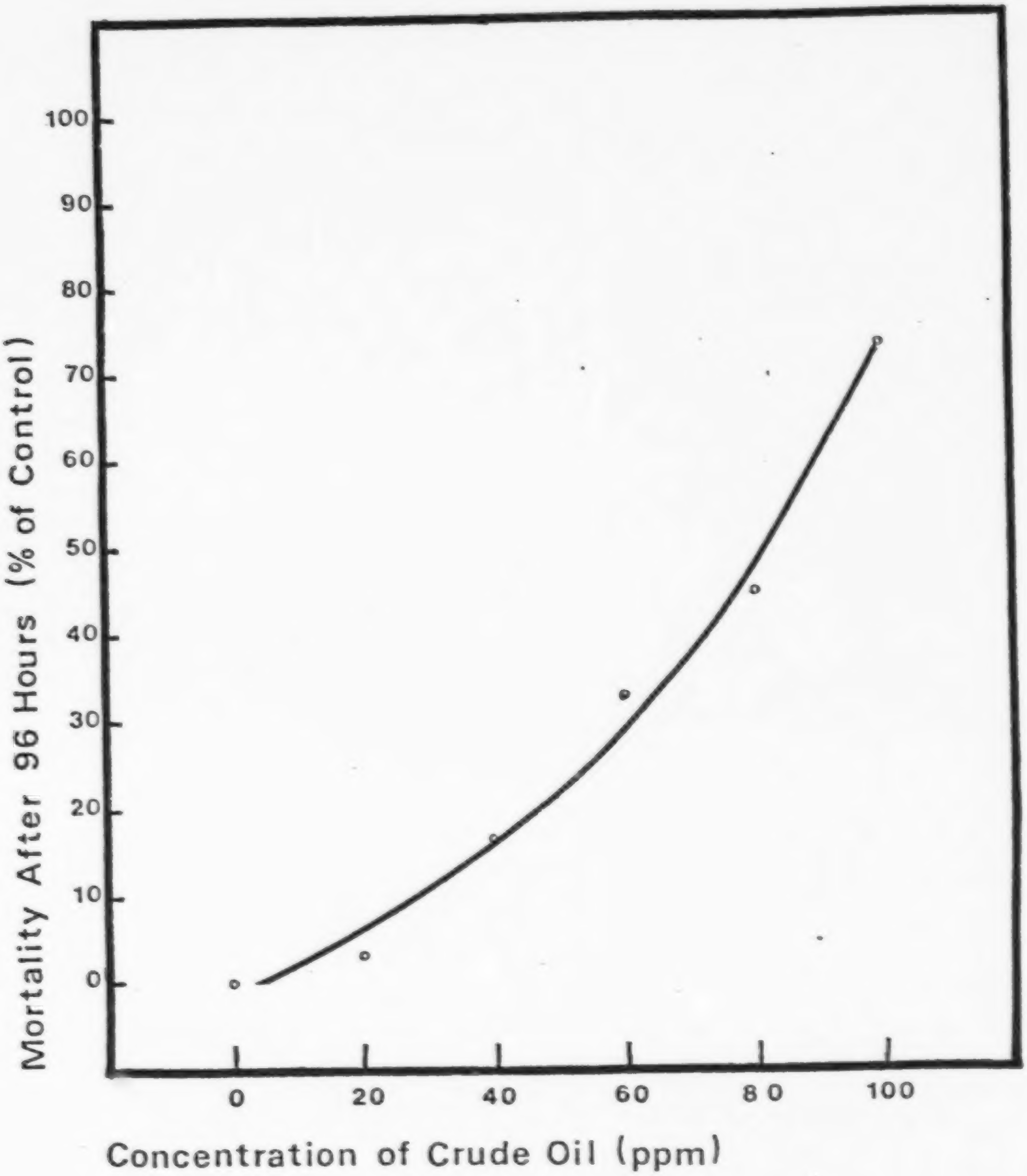
Asymptotic regression of means of population response of Euterpina acutifrons to concentrations of Iranian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 243.8 ppm calculated value (124.4 ppm actual).



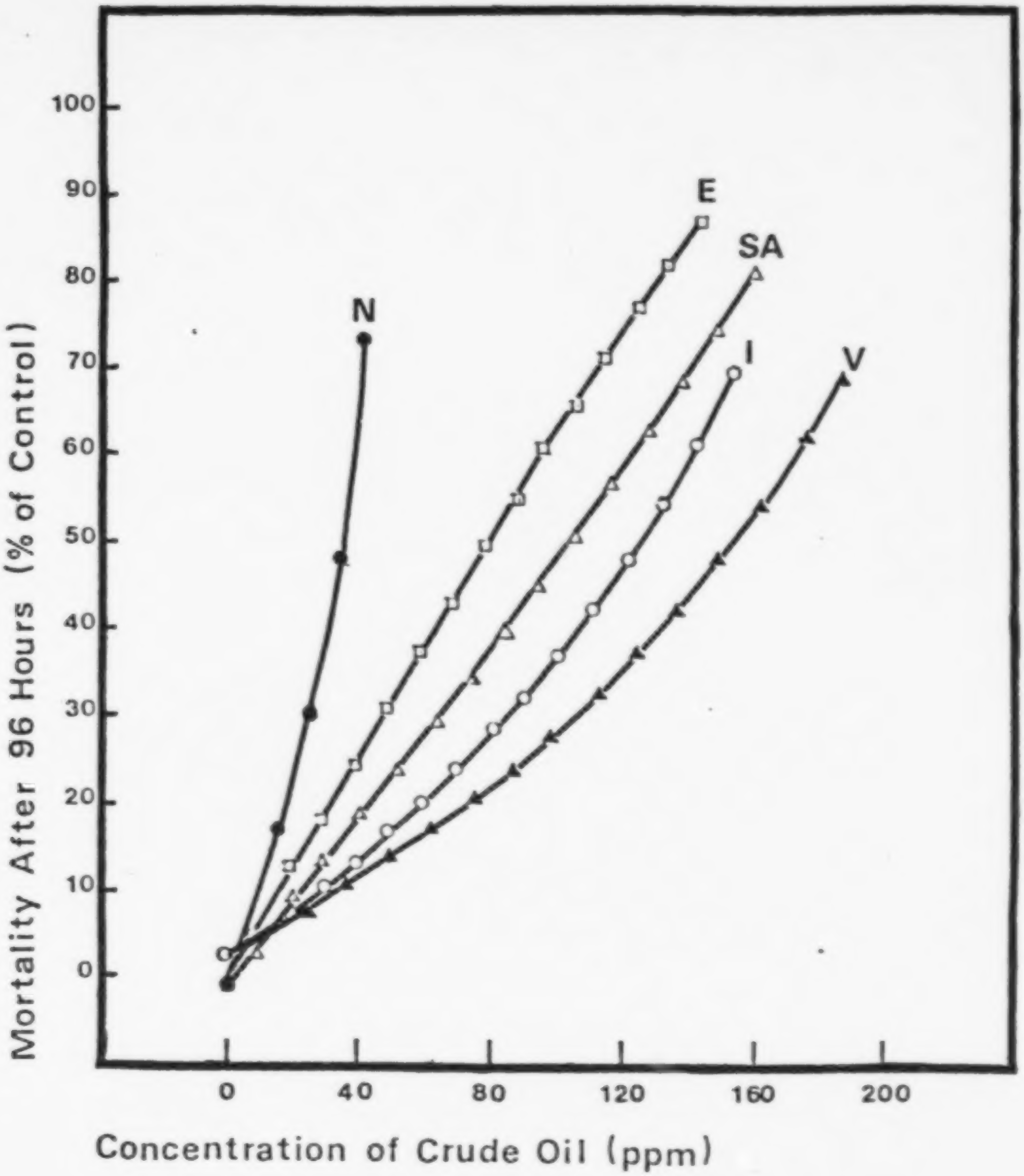
Asymptotic regression of means of population response of Euterpina acutifrons to concentrations of Venezuelan Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 245.0 ppm calculated value (151.9 ppm actual).



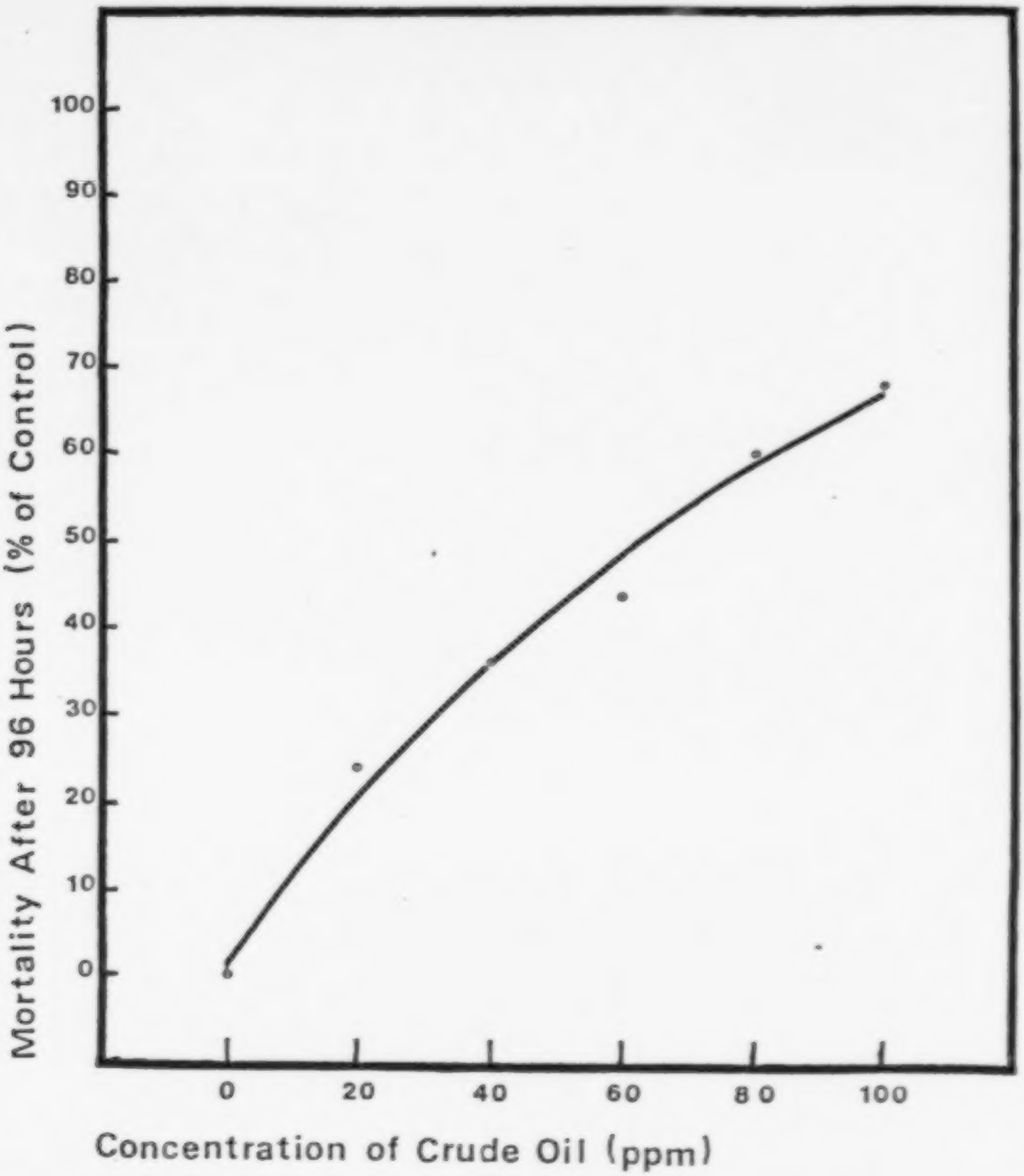
Asymptotic regression of means of population response of Euterpina acutifrons to concentrations of Saudi Arabian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 193.9 ppm calculated value (104.4 ppm actual).



Asymptotic regression of means of population response of Euterpina acutifrons to concentrations of Nigerian Crude Oil after 96 hour exposure. Based on 6 replicates, duplicate samples for each replicate. TL_{50} = 81.8 ppm calculated value (35.2 ppm actual).



Response curve for Euterpina acutifrons reduced by their percent emulsion values to common scales to compare toxicities of oil. Crude oils used were: Empire Mix (□——□), Iranian (○——○), Nigerian (●——●), Saudi Arabian (△——△), and Venezuelan (▲——▲).



Asymptotic regression of means of population response of Cyclops viridis to concentrations of Nigerian Crude Oil after 96 hour exposure. Based on 5 replicates, single sample for each replicate. TL_{50} = 62.9 ppm calculated value (27.1 ppm actual).

Hydrocarbon residue (ug/g) in potted marsh plants after 22 days exposure to Empire Mix crude oil (20 ml/pot).

Sample	Control		Oil	
Plant	GC	LC	GC	LC
Juncus roemerianus				
Live, Top Half	1.75	3.12	26.06	22.15
Bottom Half	0.97	17.79	1.78	33.05
Dead, Total	1.50	22.68	66.46	69.20
Spartina cynosuroides				
Live, Top Half	2.45	35.86	3.46	56.46
Bottom Half	1.15	19.19	1.05	55.70
Young, Total	2.38	28.21	2.53	47.03

GC = gas chromatographic determination

LC = liquid chromatographic determination

Hydrocarbon residue (ug/g) determined by LC in potted marsh plants after 30 and 60 days exposure to Empire Mix crude oil (20 and 50 ml/pot).

	30 days/20 ml		60 days/50 ml	
Marsh Plant	Control	Oil	Control	Oil
Juncus roemerianus				
Live	0	4	0	41
Dead	0	48	0	5202
Spartina cynosuroides				
Live	0	2	0	0
Dead	0	34	0	90

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Hydrocarbon residue (ug/g) determined by LC in potted marsh plants after 30 and 60 days exposure to Saudi Arabian crude oil (20 and 50 ml/pot).

	30 days/20 ml		60 days/50 ml	
Marsh Plants	Control	Oil	Control	Oil
Juncus roemerianus				
Live	0	19	0	12
Dead	0	0	0	8
Spartina cynosuroides				
Live	0	0	0	3
Dead	0	36	0	0

Hydrocarbon residue (ug/g) determined by LC in 90 and 150 days old potted marsh plants that grew from previously clipped rhizomes which had been exposed to 20 and 50 ml per pot Saudi Arabian crude oil.

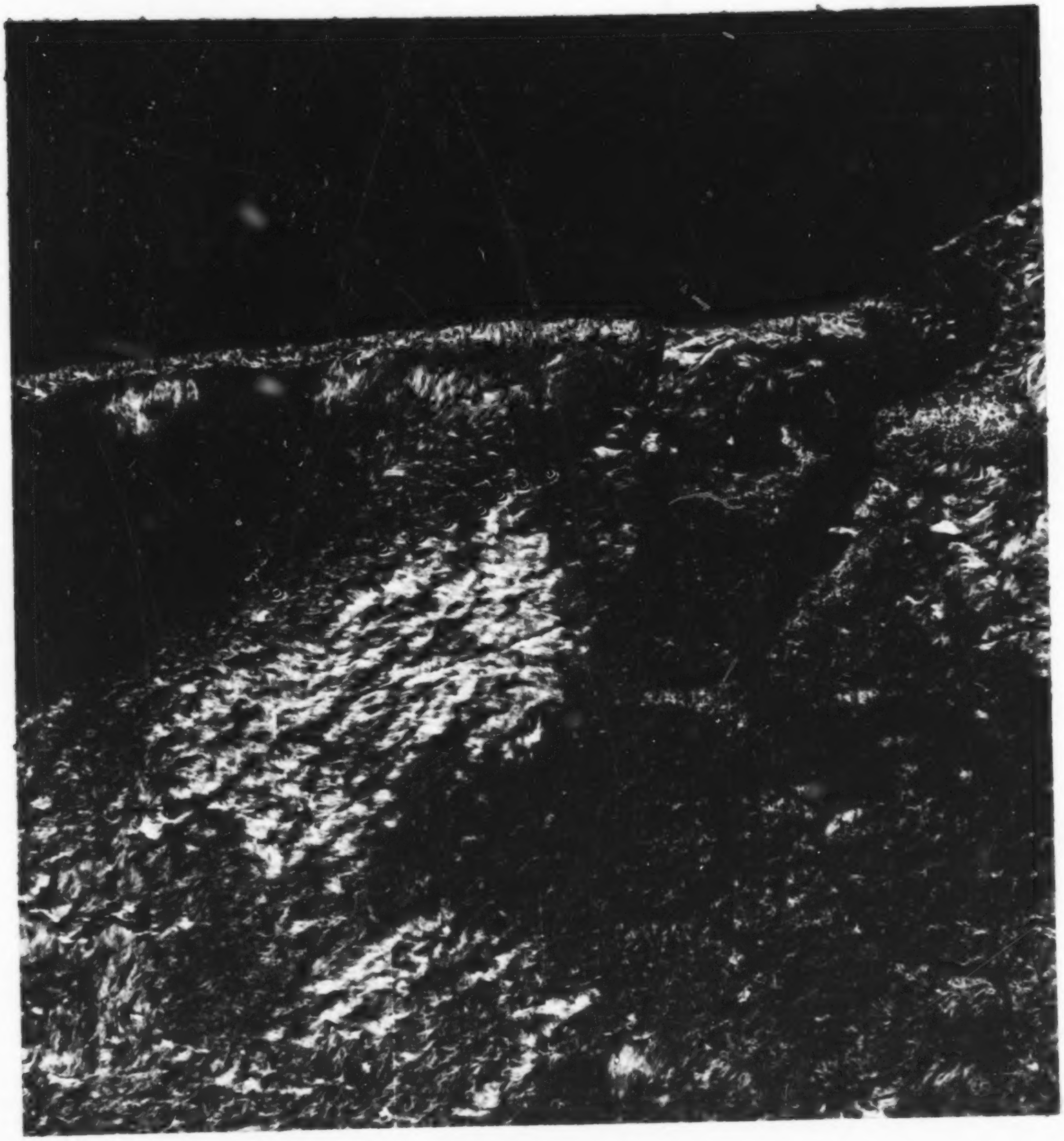
	90 days/20 ml		150 days/50 ml	
Marsh Plants	Control	Oil	Control	Oil
Juncus roemerianus				
Shoot	0	21	0	948
Root	0	2915	0	969
Spartina cynosuroides				
Shoot	0	47	0	0
Root	0	3107	0	1897

Item 72

Hydrocarbon residue (ug/g) determined by LC in 2 and 3 months old potted marsh plants that grew from previously clipped rhizomes which had been exposed to 20 and 50 ml per pot Empire Mix crude oil.

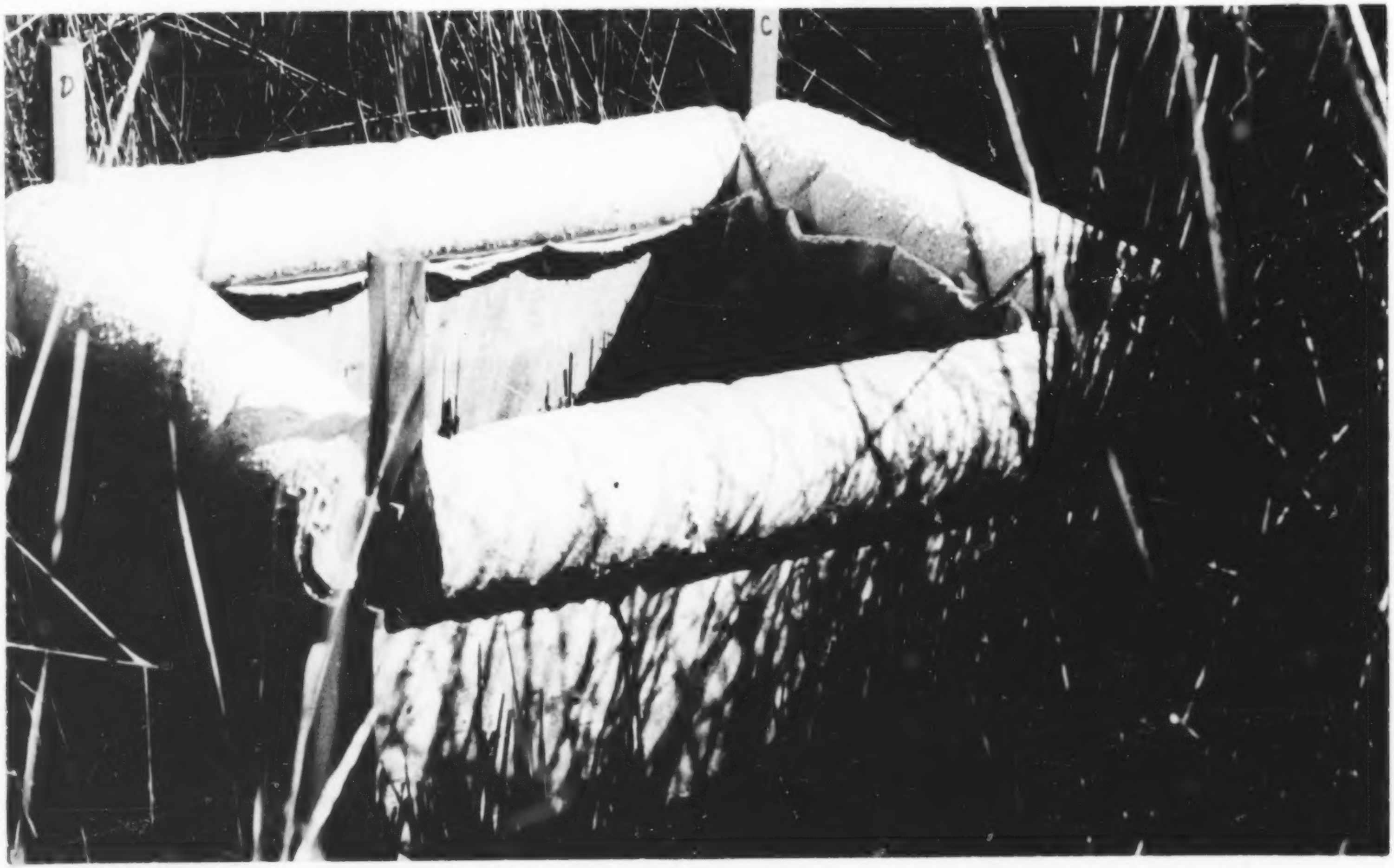
Marsh Plant	3 months/20 ml Control	3 months/20 ml Oil	2 months/50 ml Control	2 months/50 ml Oil
Juncus roemerianus				
shoots	0	4	0	0
roots	0	294	0	3768
Spartina cynosuroides				
shoots	0	745	0	0
roots	0	610	0	983

Item 73

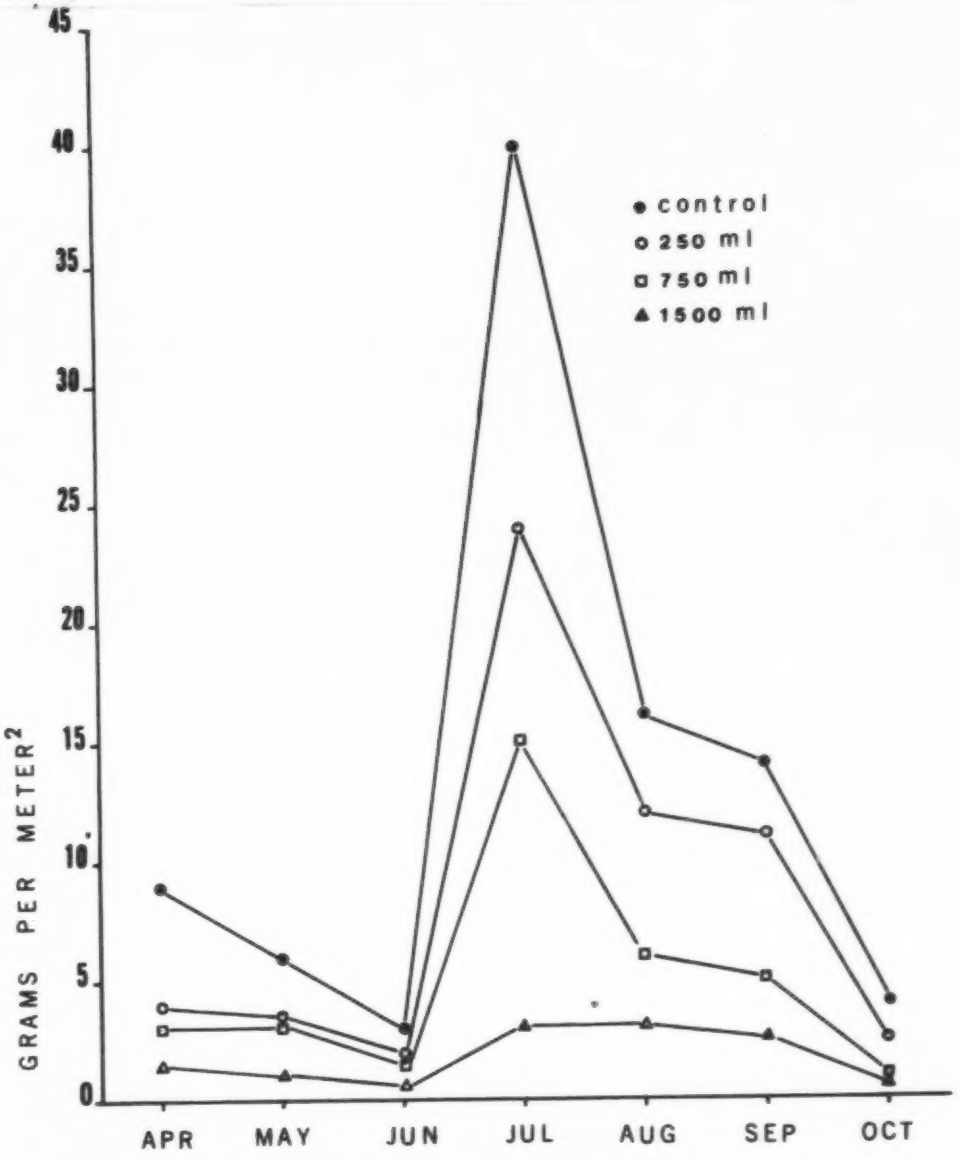


Aerial photograph of a marsh island in the St. Louis Bay Estuary. Note the experimental oil plots (3' x 3' white squares).

Item 74



Photograph of experimental oil plot (1 m^2) on the marsh enclosed by boards tightly fitted and provided with a thick roll of conweb material to prevent escape of oil to the surrounding environment.



Production of marsh plants from repeatedly clipped plots after exposure to a single spill of 250, 750, and 1500 ml Empire Mix crude oil per plot (approx. one square meter) in terms of dry biomass during spring and summer.

Number of live marsh plant tillers in 0.25 m^2 plots following initial clipping and single spill of 600 ml Empire Mix crude oil and the biomass harvested at the conclusion of the experiment after one year.

Plot		No. Tillers before spill	No. tillers after spill										Biomass Harvested (g)	
			Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Standing Plants	Detritus on Ground
Control														
Plot	1	58	58	71	73	76	75	81	81	85	71	83	144	
	2	50	45	64	65	63	61	66	76	74	75	76	152	Total 47
	3	70	65	77	79	87	99	99	106	104	96	104	196	
	4	66	67	99	98	108	101	103	125	112	101	125	205	
Oil														
Plot	1	36	28	27	15	14	14	16	21	22	13	18	48	
	2	53	41	26	10	6	9	10	5	11	11	24	15	Total 62
	3	42	28	13	6	4	8	8	10	13	10	18	31	
	4	30	25	14	4	6	7	11	14	18	11	21	54	

Item 77

Summary of production of marsh plants in 0.25 m^2 experimental plots harvested monthly (April-February) following spillage of 250 and 750 ml of Empire Mix Crude oil in March, 1973.

Control

Month	Ml. Oil Spilled	Number of Leaves		Average Leaf Length	Gram Dry Weight	
		Mean[1]	Total[2]		Mean[1]	Total[2]
April, 1973	750	31.00	124.00	22.78	6.50	26.01
	250	50.25	201.00	24.04	7.80	31.19
May, 1973	750	38.75	155.00	19.34	4.77	19.09
	250	46.00	184.00	19.41	4.46	17.85
June, 1973	750	21.50	86.00	19.79	2.67	10.69
	250	22.25	89.00	19.46	2.59	10.37
July, 1973	750	29.75	119.00	---[3]	10.81	43.22
	250	33.50	134.00	---	8.99	35.96
August, 1973	750	20.50	82.00	---	3.03	12.13
	250	30.50	122.00	---	2.90	11.60
September, 1973	750	20.75	83.00	37.75	4.44	17.75
	250	25.00	100.00	33.25	2.91	11.65
October, 1973	750	10.75	43.00	22.50	0.74	2.95
	250	14.50	58.00	15.00	0.67	2.69
November, 1973	750	8.75	35.00	15.50	0.20	0.78
	250	7.25	29.00	12.25	0.20	0.78
December, 1973	750	6.50	26.00	8.25	0.10	0.41
	250	5.75	23.00	7.50	0.09	0.35
January, 1974	750	14.25	57.00	13.50	0.45	1.81
	250	12.25	49.00	11.00	0.40	1.59
February, 1974	750	28.50	114.00	36.50	2.61	10.43
	250	21.25	85.00	33.25	2.01	8.04

---

[1] Mean of four 0.25 m^2 subplots.

[2] Total for whole 1 m^2 plot.

[3] Not recorded for these months.

Item 78

Summary of the production of marsh plants in 0.25 m^2 experimental plots harvested monthly following spillage of 1500 ml of Empire Mix crude oil in December 1973.

Control

Month	Quadrat No.	Number of Leaves		Average Leaf Length	Gram Dry Weight	
		Mean[1]	Total[2]		Mean[1]	Total[2]
January	Q I	---[3]	137	---[3]	---[3]	19.10
	II	---	205	---	---	17.07
February	Q I	---	229	---	---	34.76
	II	---	256	---	---	35.64
March	Q I	41.75	167	26.21	9.47	37.87
	II	42.00	168	23.60	8.66	34.62
April	Q I	41.75	167	12.58	10.22	40.89
	II	46.50	186	13.02	11.21	44.82
May	Q I	29.00	116	25.45	5.16	20.63
	II	42.25	169	21.81	7.60	30.38
June	Q I	14.75	59	21.82	1.95	7.80
	II	27.50	110	24.61	3.48	13.90
July	Q I	26.25	105	---[3]	11.82	47.29
	II	35.25	141	---	9.56	38.23
August	Q I	25.50	102	---	4.38	17.52
	II	30.75	123	---	3.78	15.10
September	Q I	19.00	76	49.75	3.83	15.31
	II	18.00	72	45.00	3.04	12.15
October	Q I	9.25	37	23.00	1.09	4.35
	II	6.75	27	21.50	0.85	3.38
November	Q I	5.00	20	13.75	0.13	0.52
	II	6.75	27	12.50	0.28	1.11
December	Q I	5.25	21	6.25	0.03	0.13
	II	3.75	15	4.50	0.08	0.30

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[1] Mean of four 0.25 m^2 subplots.

[2] Total of whole 1 m^2 plot.

[3] Not recorded for these months.

Item 79

Number of new shoots or tillers that grew from plots that were spilled with Empire Mix crude oil, repeatedly harvested for 12 consecutive months, and respilled with the same amount of oil.

Plot-treatment	Number of tillers after 34 days	68 days	92 days	Total biomass (g) after 137 or 160 days*
1500 ml				
Oil plot 1	6	5	4	10.3
Oil plot 2	3	0	4	10.2
Control plot 1	29	39	41	269.5
Control plot 2	24	27	30	127.8
750 ml				
Oil plot		18	18	29.9
Control plot		118	129	109.9
250 ml				
Oil plot		33	43	65.5
Control plot		92	101	84.8

---

*137 days for the 250 ml and 750 ml oil per plot experiments;
160 days for the 1500 ml oil per plot experiment

Duncan Multiple Range Test showed control plots different from oil plots; oil plots different among each other.

Item 80

Number of alive tillers (i.e., number of single shoots arising from rhizomes) and total biomass (grams) present in 0.25 m^2 plots after about one year growth successive monthly oiling with Saudi Arabian crude oil at the rate of 150 ml oil per plot.

No. Oilings	Replicates (Subplots)	No. Tillers (Standing Shoots)	Total Standing Biomass (dry gram)	Detritus on Ground (dry gram)
0	1	83	143.6	46.7
	2	76	152.0	
	3	104	196.2	
	4	125	205.3	
1	1	77	133.1	67.1
	2	36	54.4	
	3	49	132.2	
	4	68	97.9	
2	1	63	104.9	124.9
	2	64	93.3	
	3	54	84.6	
	4	61	116.3	
4	1	24	40.5	178.0
	2	23	45.4	
	3	27	52.6	
	4	15	26.4	
6	1	4	21.7	171.8
	2	0	30.6	
	3	2	18.5	
	4	5	28.8	
8	1	5	54.5	250.5
	2	0	12.1	
	3	0	29.2	
	4	4	18.3	
10	1	0	35.1	212.9
	2	1	50.5	
	3	2	24.5	
	4	7	51.2	

Item 81

Number and height of tillers in a Juncus marsh experimental plot (0.25 m^2) following initial clipping and repeated spills of 150 ml Per plot Saudi Arabian oil.

		2-8-75				2-28-75				4-4-75			
			Height (cm)				Height (cm)				Height (cm)		
No. Oilings	No. Plots	No. Tillers	Short	Med.	Tall	No. Tillers	Short	Med.	Tall	No. Tillers	Short	Med.	Tall
0	A	58				58	12	20	37	71	12	30	58
	B	50				45	14	26	39	64	9	33	65
	C	70				65	14	27	32	77	12	40	75
	D	66				67	12	26	42	99	13	46	69
1	A	56				33		22	41	29	17	46	75
	B	42				23	13	17	22	15	10	22	34
	C	41				28	11	20	28	30	9	37	53
	D	53				41	12	20	35	35	20	50	83
2	A	52				40	7	17	27	32	15	30	69
	B	44				36	15	26	30	20	22	35	52
	C	41				19	6	23	31	21	14	35	62
	D	61				42	16	25	44	37	23	40	66
4	A	46				25	13	26	29	17	12	31	57
	B	58				37	9	21	31	22	10	30	54
	C	56				41	16	24	30	31	15	31	45
	D	48				47	17	24	32	31	8	43	60
6	A	47				32	17	27	31	20	13	22	59
	B	44				20	12	30	35	10	13	21	71
	C	37				19	17	26	31	13	26	31	49
	D	46				29	14	19	26	25	19	38	51
8	A	66				48	14	27	51	43	12	30	59
	B	19				12	11	15	28	13	17	31	54
	C	39				28	7	20	27	15	20	22	46
	D	54				41	19	24	37	30	12	29	76
10	A	53				34	6	15	38	31	14	25	54
	B	56				35	6	12	19	17	14	23	49
	C	52				27	15	23	35	24	10	25	62
	D	40				23	15	27	35	29	19	22	67

Item 82

Growth of marsh plants from previously spilled (1500 ml) plots which were repeatedly harvested for 12 consecutive months and respilled with 1500 ml Empire Mix crude oil. Replicate (R) represents 1 quadrat or 0.25 of the m^2 plots.

Plots	Replicates	34 Days No. Tillers	34 Days Height (cm) Short	 Med.	 Tall	68 Days No. Tillers	68 Days Height (cm) Short	 Med.	 Tall
Control I	R_1	6	17	27	38	10	16	26	61
	R_2	11	14	24	34	16	9	25	36
	R_3	6	9	27	34	6	29	38	68
	R_4	6	16	23	30	7	25	38	54
Control II	R_1	8	9	21	36	13	14	25	49
	R_2	6	5	34	41	6	17	29	34
	R_3	7	8	23	41	6	9	35	52
	R_4	3	8	13	18	2	17	34	--
Oil I	R_1	2	--	28	42	2	--	30	50
	R_2	1	6	--	--	0	--	--	--
	R_3	0	--	--	--	0	--	--	--
	R4	3	27	37	38	3	--	37	67
Oil II	R_1	0	--	--	--	0	--	--	--
	R_2	1	9	--	--	0	--	--	--
	R_3	0	--	--	--	0	--	--	--
	R_4	2	7	27	--	0	--	--	--

Item 83

Growth of marsh plants from previously spilled (750 and 250 ml) plots which were repeatedly harvested monthly for 12 consecutive months and respilled with 750 and 250 ml of Empire Mix crude oil. Replicate (R) represents 1 quadrat or 0.25 of the m^2 plots.

Plots		Replicates	68 Days				92 Days				137 Days Expt. Terminated
			No. Tillers	Height (cm) Short	Med.	Tall	No. Tillers	Height (cm) Short	Med.	Tall	Total Biomass (g)
Control	750	R_1	43	2	24	50	44	16	40	80	48.9
		R_2	18	5	10	24	17	17	25	48	10.4
		R_3	29	2	18	29	35	9	20	58	20.1
		R_4	28	2	20	32	33	4	30	69	30.5
Control	250	R_1	32	6	17	33	38	4	22	60	26.3
		R_2	33	4	23	40	33	3	20	68	29.6
		R_3	11	7	25	31	15	14	26	56	8.7
		R_4	16	5	24	30	15	12	25	50	20.2
Oil	750	R_1	9	13	15	24	9	8	22	49	6.1
		R_2	6	--	30	36	6	26	40	72	14.0
		R_3	3	15	17	24	3	15	30	44	9.8
		R_4	0	--	--	--	0	--	--	--	0.0
Oil	250	R_1	8	6	25	30	8	20	40	80	11.6
		R_2	4	5	21	24	6	10	40	50	10.9
		R_3	3	3	12	26	3	10	20	40	10.2
		R_4	18	4	27	33	26	15	32	77	32.8

Item 84

Hydrocarbon residue (mg/g) in marsh plants three (4/2/75) months after spillage of varying amounts of Empire Mix crude oil.

	1500 ml/plot		750 ml/plot		250 ml/plot	
Treatment	LC	GC	LC	GC	LC	GC
Control						
Alive, Top	95	0	0		0	
Bottom	95	0	0		0	
Dead, Top	--	--	0		0	
Bottom	242	0	0		0	
Oil						
Alive, Top	1761	19	0		3	
Bottom	11,596	395	12		0	
Dead, Top	--	-	0		0	
Bottom	14,434	168	100		0	

Item 85

Hydrocarbon residue (mg/g) in marsh planis six (7/30/75) months after spillage of varying amounts of Empire Mix crude oil.

	1500 ml/plot		750 ml/plot		250 ml/plot	
Treatment	LC	GC	LC	GC	LC	GC
Control						
Plot 1						
Alive, Top	0	16	0	11	0	20
Bottom	0	5	0	4	0	2
Dead, Top	0	13	0	20	0	11
Bottom	0	13	0	20	0	8
Plot 2						
Alive, Top	0	14				
Bottom	0	1				
Dead, Top	0	8				
Bottom	0	8				
Oil						
Plot 1						
Alive, Top	0	12	0	13	0	5
Bottom	440	4	925	77	163	16
Dead, Top	0	10	0	13	0	13
Bottom	2554	128	4409	478	445	36
Plot 2						
Alive, Top	0	12				
Bottom	2103	740				
Dead, Top	2813	0				
Bottom	7325	1923				

Item 86

Hydrocarbon residue (mg/g) in marsh plants nine (11/26/ 75) months after spillage of varying amounts of Empire Mix crude oil.

Treatment	1500 ml/plot LC	1500 ml/plot GC	750 ml/plot LC	750 ml/plot GC	250 ml/plot LC	250 ml/plot GC
Control						
Plot 1						
Alive, Top	0		0		0	
Bottom	0		0		0	
Dead, Top	0		0		0	
Bottom	0		0		0	
Plot 2						
Alive, Top	0					
Bottom	0					
Dead, Top	0					
Bottom	0					
Oil						
Plot 1						
Alive, Top	0		2		0	
Bottom	0		0		0	
Dead, Top	0		0		0	
Bottom	0		19		24	
Plot 2						
Alive, Top	0					
Bottom	0					
Dead, Top	4					
Bottom	64					

Item 87

Hydrocarbon residue (mg/g) in marsh plants twelve (2/7/75) months after spillage of varying amount of Empire Mix crude oil.

	1500 ml/plot		750 ml/plot		250 ml/plot	
Treatment	LC	GC	LC	GC	LC	GC
Control						
Plot 1						
Alive, Top	0		0		0	
Bottom	0		0		0	
Dead, Top	0		0		0	
Bottom	0		0		0	
Plot 2						
Alive, Top	0					
Bottom	0					
Dead, Top	0					
Bottom	0					
Oil						
Plot 1						
Alive, Top	1		0		0	
Bottom	1		0		0	
Dead, Top	0		22		3	
Bottom	0		8		119	
Plot 2						
Alive, Top	3					
Bottom	0					
Dead, Top	0					
Bottom	3					

Item 88

Hydrocarbon residue in marsh plant roots recovered from core samples collected from experimental plots exposed to a total of 3000 ml Empire Mix crude oil delivered at the rate of 1500 ml in 12 months interval.

Plot	Depth(cm)	Dry Biomass (gm)	Oil Hydrocarbon[1] LC (ug/g)	GC[2]
Core from inside experimental plots.				
Control I	0-10	31.00	0	2
	10-20	25.02	0	3
	20-30	13.30	0	6
	30-40	7.93	0	5
Control II	0-10	24.84	0	3
	10-20	18.11	0	7
	20-30	11.39	0	4
	30-40	6.09	0	1
Oil I	0-10	30.97	102	75
	10-20	23.34	0	26
	20-30	17.16	0	10
	30-40	8.02	0	6
Oil II	0-10	24.71	106	35
	10-20	28.60	0	8
	20-30	18.96	0	4
	30-40	10.16	6	9
Core from outside experimental plots.				
Control	0-10	26.24	0	4
	10-20	23.39	0	6
	20-30	12.87	0	5
	30-40	11.05	0	1
Oil	0-10	23.04	63	3
	10-20	26.82	4	4
	20-30	19.31	4	2
	30-40	9.84	0	2

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[1] LC = liquid chromatographic determination
GC = gas chromatographic determination

In situ decomposition rates of and oil residue in dead *Juncus* leaves impregnated with crude oil (rate expressed as per cent loss of original material after 11 months of in situ decomposition).

	Per Cent Decomposition		Hydrocarbon Residue in Oil Samples (μg/g)*	
No. of Days in the Field	Control	Oil	LC (aromatic)	GC (aliphatic)
Empire Mix Crude Oil				
91	20.4	6.9	1,631	412
176	15.1	11.6	196	112
263	49.6	24.6	1,284	0
323	66.5	31.7	1,042	0
Saudi Arabian Crude Oil				
91	20.4	1.6	18,464	21,301
176	15.1	1.6	15,383	3,585
263	49.6	19.9	11,551	0
323	66.5	31.73	10,313	0

*LC = liquid chromatographic determination
GC = gas chromatographic determination

Item 89

Item 90

Relative 96 hr toxicities of Empire Mix, Saudi Arabian, Nigerian, Venezuelan and Iranian crude oils to 3-6 in mullet.

		# Organisms Responding		% Mortalities	
Crude Oil	Conc.	Control	Treated	Control	Treated
Empire Mix	100	0/10	0/10	0	0
	250	0/5	0/5	0	0
	300	0/5	0/5	0	0
	350	0/10	1/10	0	10
	400	0/5	0/10	0	0
	800	0/8	0/16	0	0
	1000	1/18	11/18	6	61
Saudi Arabian	250	0/12	1/6	0	17
	275	0/12	0/24	0	0
	325	0/12	11/12	0	91
	350	0/12	6/6	0	100
	400	0/12	5/5	0	100
	500	0/11	34/34	0	100
Nigerian	400	0/10	6/6	0	100
	200	0/10	6/6	0	100
Venezuelan	800	0/6	4/6	0	67
	400	0/6	4/6	0	67
Iranian	400	0/6	1/6	0	17

Item 91

Enzyme Levels in Muscle Tissue from Mullet Exposed to 75 ppm Empire Mix Crude Oil for 4 Days

Enzyme	Fraction[b]	Specific Activity[a] Control	Specific Activity[a] Treated
ACHE	H	348.82 ± 68.10 (5)	544.43 ± 65.39 (7)
ACP	H	4.83 ± 1.71 (4)	3.14 ± 1.46 (8)
ALP	H	2.64 ± 0.40 (4)	1.87 ± 0.34 (8)
CYT OX	M	38.71 ± 12.74 (3)	42.03 ± 9.14 (8)
CYT RED	S	1.00 ± 0.62 (2)	1.25 ± 0.36 (6)
B-GLU	M	506.10 ± 73.40 (2)	73.30 ± 42.38 (6)+
B-GLU	S	141.43 ± 33.99 (2)	23.01 ± 26.15 (7)
GOT	M	328.60 ± 65.67 (4)	293.57 ± 47.88 (8)
GOT	S	216.33 ± 40.74 (4)	227.59 ± 29.07 (8)
GPT	M	24.22 ± 9.37 (4)	31.42 ± 6.83 (8)
GPT	S	26.01 ± 7.31 (4)	20.51 ± 5.33 (8)
LDH	M	2579.42 ± 585.64 (3)	2523.43 ± 500.57 (4)
LDH	S	6504.14 ± 778.93 (3)	4813.70 ± 665.77 (4)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] H fraction is defined as the supernatant from an 800 g/10-min centrifugation.
M fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.
S fraction is defined as the supernatant from an 8000 g centrifugation.
+ Treated significantly different from control ($\underline{P} < 0.05$).

Item 92

Enzyme Levels in Brain Tissue from Mullet Exposed to 75 ppm Empire Mix Crude Oil for 4 Days

Enzyme	Fraction[b]	Specific Activity[a] Control	Treated
ACHE	H	191.42 ± 14.46 (5)	158.33 ± 13.24 (8)
ACP	H	8.76 ± 1.31 (4)	5.60 ± 1.12 (8)
ALP	H	13.85 ± 5.30 (4)	12.87 ± 4.51 (8)
CYT OX	M	95.06 ± 12.49 (3)	86.93 ± 7.82 (9)
CYT RED	S	3.64 ± 0.77 (2)	2.68 ± 0.49 (5)
B-GLU	M	53.60 ± 28.45 (2)	120.31 ± 21.88 (7)+
B-GLU	S	65.38 ± 12.53 (2)	71.02 ± 9.64 (7)
GOT	M	308.27 ± 50.78 (4)	173.47 ± 37.02 (8)
GOT	S	360.51 ± 45.11 (4)	349.70 ± 32.89 (8)
GPT	M	40.91 ± 13.62 (4)	20.45 ± 9.93 (8)
GPT	S	32.25 ± 8.23 (4)	33.71 ± 6.00 (8)
LDH	M	598.50 ± 64.71 (3)	614.08 ± 55.31 (4)
LDH	S	982.34 ± 310.54 (3)	1150.43 ± 265.42 (4)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] H fraction is defined as the supernatant from an 800 g/10-min centrifugation.
M fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.
S fraction is defined as the supernatant from an 8000 g centrifugation.
+ Treated significantly different from control ($\underline{P} < 0.05$).

Item 93

Enzyme Levels in Liver Tissue from Mullet Exposed to 75 ppm Empire Mix Crude Oil for 4 Days

Enzyme	Fraction[b]	Specific Activity[a]	
		Control	Treated
ACP	H	47.91 ± 4.41 (5)	44.13 ± 3.65 (11)
ALP	H	28.91 ± 3.37 (5)	20.82 ± 2.79 (11)
CYT OX	M	118.78 ± 31.10 (3)	125.71 ± 19.47 (9)
CYT RED	S	5.20 ± 1.05 (2)	5.22 ± 0.56 (7)
B-GLU	M	4144.73 ± 1439.56 (2)	3295.85 ± 1107.47 (7)
B-GLU	S	1669.00 ± 363.40 (2)	1622.58 ± 279.57 (7)
GOT	M	331.37 ± 80.50 (4)	472.96 ± 58.69 (8)
GOT	S	454.26 ± 51.50 (4)	304.48 ± 37.55 (8)
GPT	M	204.73 ± 64.13 (4)	305.53 ± 46.76 (8)
GPT	S	258.33 ± 24.82 (5)	239.11 ± 18.10 (8)
LDH	H	216.35 ± 107.63 (3)	109.30 ± 92.00 (4)
LDH	S	124.75 ± 23.47 (3)	130.88 ± 20.06 (4)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] H fraction is defined as the supernatant from an 800 g/10-min centrifugation.

M fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.

S fraction is defined as the supernatant from an 8000 g centrifugation.

Item 94

Enzyme Levels in Gill Tissue from Mullet Exposed to 75 ppm Empire Mix Crude Oil for 4 Days

Enzyme	Fraction[b]	Specific Activity[a] Control	 Treated
ACP	H	33.79 ± 4.58 (4)	25.13 ± 3.90 (8)
ALP	H	43.13 ± 13.60 (4)	38.34 ± 11.59 (8)
CYT OX	M	79.48 ± 19.71 (3)	77.44 ± 12.34 (9)
CYT RED	S	1.91 ± 0.80 (2)	2.15 ± 0.43 (7)
B-GLU	M	591.95 ± 106.16 (2)	644.08 ± 81.67 (7)
B-GLU	S	295.75 ± 42.90 (2)	224.64 ± 33.01 (7)
GOT	M	512.75 ± 60.99 (4)	366.57 ± 44.47 (8)
GOT	S	180.34 ± 47.78 (4)	221.01 ± 34.84 (8)
GPT	M	67.97 ± 25.41 (4)	77.89 ± 18.52 (8)
GPT	S	18.01 ± 13.15 (4)	26.60 ± 9.59 (8)
LDH	M	479.81 ± 61.20 (3)	302.43 ± 52.31 (4)
LDH	S	980.80 ± 75.12 (3)	1011.65 ± 64.20 (4)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] H fraction is defined as the supernatant from an 800 g/10-min centrifugation.
M fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.
S fraction is defined as the supernatant from an 8000 g centrifugation.

Item 95

Enzyme Specific Activities in Tissues of Mullet Injected with 100 µl Empire Mix Crude Oil [mean ± SE (N)].

Tissue	Enzyme[2]	Fraction[3]	Specific Activity[1]	
			Control	4 Days
Brain	CYT OX	m	46.69 ± 1.02 (2)	49.06 ± 19.26 (2)
		s	---	---
	CYT RD	s	2.96 ± 0.50 (2)	3.56 ± 0.09 (2)
	GLU	m	89.45 (1)	70.06 ± 20.62 (2)
		s	54.27 ± 3.98 (2)	42.17 ± 6.47 (2)
	GOT	m	154.45 ± 14.85 (2)	179.10 ± 33.40 (2)
		s	625.05 ± 30.45 (2)	795.75 ± 75.75 (2)
	GPT	m	44.70 ± 3.80 (2)	58.60 ± 12.80 (2)
		s	121.30 ± 53.30 (2)	87.45 ± 10.65 (2)
	LDH	m	716.30 ± 22.70 (2)	778.65 ± 41.15 (2)
		s	1723.60 ± 24.80 (2)	2061.70 ± 79.20 (2)
	MDH	m	3574.30 (1)	4705.00 (1)
		s	3949.80 (1)	4358.00 (1)
	HBDH	m	236.70 ± 126.80(2)	259.05 ± 134.95(2)
		s	579.65 ± 367.25(2)	481.85 ± 280.05(2)
	LAP	m	0.00	0.00
		s	5.90 ± 2.30(2)	3.77 ± 0.23(2)
Gill	CYT OX	m	55.92 ± 35.85(2)	70.30 ± 44.51(2)
		s	3.34 ± 2.27(2)	7.49 ± 0.57(2)
	CYT RD	s	1.96 ± 0.54(2)	2.06 ± 0.15(2)
	GLU	m	585.88 ± 29.38(2)	440.90 ± 93.32(2)
		s	216.91 ± 20.28(2)	159.97 ± 32.53(2)
	GOT	m	321.10 ± 11.50(2)	338.65 ± 9.85(2)
		s	222.45 ± 1.05(2)	1111.45 ± 918.55(2)
	GPT	m	108.75 ± 1.95(2)	71.35 ± 47.25(2)
		s	38.40 ± 0.40(2)	33.05 ± 2.15(2)
	LDH	m	555.30 ± 53.90(2)	541.85 ± 75.55(2)
		s	1118.30 ± 43.70(2)	1065.15 ± 27.05(2)

Item 95 (cont.)

Tissue	Enzyme[2]	Fraction[3]	Specific Activity[1]	
			Control	4 Days
	MDH	m	3036.00 (1)	3137.00 (1)
		s	2095.00 (1)	2043.00 (1)
	HBDH	m	265.25 ± 163.85(2)	196.85 ± 121.35(2)
		s	329.70 ± 176.10(2)	322.30 ± 167.50(2)
	LAP	m	0.00	0.00
		s	7.33 ± 1.13(2)	8.06 ± 1.69(2)
Liver	CYT OX	m	84.95 ± 3.37(2)	119.03 ± 66.65(2)
		s	4.61 ± 0.13(2)	12.10 ± 9.61(2)
	CYT RD	s	4.48 ± 1.44(2)	4.80 ± 0.19(2)
	GLU	m	1715.91 ± 85.46(2)	1987.85 ± 515.87(2)
		s	1330.76 ± 201.93(2)	1595.40 ± 886.20(2)
	GOT	m	523.75 ± 57.35(2)	309.45 ± 78.85(2)
		s	509.25 ± 185.25(2)	382.30 ± 72.30(2)
	GPT	m	297.85 ± 46.45(2)	160.65 ± 17.65(2)
		s	275.60 ± 10.10(2)	336.90 ± 37.50(2)
	LDH	m	56.95 ± 43.05(2)	94.70 ± 14.50(2)
		s	204.60 ± 5.50(2)	195.90 ± 3.60(2)
	MDH	m	5121.00 (1)	3215.00 (1)
		s	5352.00 (1)	6482.00 (1)
	HBDH	m	45.90 ± 11.40(2)	59.65 ± 14.15(2)
		s	60.45 ± 31.45(2)	60.20 ± 28.50(2)
	LAP	m	10.02 ± 4.38(2)	8.64 ± 2.84(2)
		s	11.90 ± 0.40(2)	19.75 ± 3.35(2)
Muscle	CYT OX	m	33.60 ± 19.50(2)	18.11 ± 8.00(2)
		s	2.32 ± 0.41(2)	1.83 ± 0.78(2)
	CYT RD	s	0.97 ± 0.06(2)	0.69 ± 0.10(2)
	GLU	m	51.98 ± 25.52(2)	47.64 ± (1)
		s	34.07 ± 1.85(2)	36.13 ± 13.13(2)

Item 95 (cont.)

Tissue	Enzyme[2]	Fraction[3]	Specific Activity[1]	
			Control	4 Days
	GOT	m	288.85 ± 91.55(2)	294.60 ± 43.20(2)
		s	381.10 ± 38.00(2)	266.70 ± 79.70(2)
	GPT	m	73.00 ± 11.10(2)	92.15 ± 0.95(2)
		s	71.85 ± 7.95(2)	61.00 ± 9.60(2)
	LDH	m	2962.35 ± 460.75(2)	2991.25 ± 271.25(2)
		s	6087.55 ± 503.85(2)	6413.35 ± 946.25(2)
	MDH	m	2430.00 (1)	2297.00 (1)
		s	2158.00 (1)	2069.00 (1)
	HBDH	m	334.85 ± 238.24(2)	280.90 ± 186.30(2)
		s	599.65 ± 369.45(2)	579.85 ± 354.95(2)
	LAP	m	0.00	5.07 (1)
		s	5.12 ± 1.72(2)	6.30 ± 2.11(2)

---

[1] Specific activity is expressed as millimicromoles product formed per minute per mg protein

[2] CYT OX = cytochrome oxidase
CYT RD = NADPH - cytochrome c reductase
GLU = β-glucuronidase
GOT - glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; LDH = lactic dehydrogenase; MDH = malic dehydrogenase; HBDH = α-hydroxybutyric acid dehydrogenase; LAP = leucine aminopeptidase; SDH = sorbitol dehydrogenase.

[3] m = that portion of an 800 xg (10 min) supernatant sedimented at 8000 xg for 15 min.

s = the supernatant of an 8000 xg (15 min) centrifugation.

Item 96

In vitro time dependent inhibition of mullet liver got by Empire Mix crude oil

Addition to Incubation [a]		Time of Incubation [b] (hr)			
Oil (ppm)	Other	0	1	2	3
0	H_2O	100	93	83	80
0	H_2O-acetone-ether	100	86	77	72
10	H_2O-acetone-ether	100	89	79	76
30	H_2O-acetone-ether	100	90	82	72
50	H_2O-acetone-ether	100	87	78	71
70	H_2O-acetone-ether	100	86	77	69
80	H_2O-acetone-ether	100	87	80	75

[a] GOT incubated in the presence of varying concentrations of Empire Mix crude oil. Acetone-ether additions were used to increase solubility. Water only should be considered primary control.

[b] Data presented as mean of three determinations.

IN VITRO TIME INDEPENDENT INHIBITION OF MULLET LIVER GOT BY EMPIRE MIX CRUDE OIL

Addition to Assay System [a]		Enzyme Activity [b]
Oil (ppm)	Other	Units
0	H_2O	52.57
0	H_2O-acetone-ether	52.68
14	H_2O-acetone-ether	52.14
28	H_2O-acetone-ether	51.07

[a] Oil was added directly to the assay system. Acetone-ether additions were used to increase solubility. Water only should be considered primary control.

[b] Data presented as mean of three determinations.

Item 98

The effect of a 4 day exposure to 75 ppm emulsified crude oil on liver size, hepatic protein, and mixed-function oxidase activity in mullet.

Parameter	Control	Empire Mix		Saudi Arabian	
	Level	Level	% Effect	Level	% Effect
Liver wgt:body wgt[2]	1.48 ± 0.19	2.17 ± 0.21	+47*	2.34 ± 0.21	+58*
Total protein[3]	0.17 ± 0.01	0.14 ± 0.01	-18	0.12 ± 0.01	-29**
Microsomal protein[4]	7.40 ± 0.45	6.37 ± 0.47	-14	5.37 ± 0.53	-27*
Cytochrome P-450[5]	13.26 ± 3.42	39.71 ± 5.36	+199**	30.24 ± 6.16	+128*
Cytochrome b_5[5]	8.35 ± 1.66	14.44 ± 1.68	+73*	11.02 ± 1.33	+32
NADPH Cytochrome *c* Reductase[6]	3.85 ± 0.65	6.12 ± 0.81	+59	4.03 ± 0.44	+ 5
NADPH DCIP Reductase[6]	2.41 ± 0.40	4.77 ± 0.73	+98*	3.03 ± 0.48	+26
NADH Cytochrome b_5 Reductase[6]	46.59 ± 8.93	52.93 ± 3.69	+14	39.39 ± 5.52	-15
NADH Cytochrome b_5 Reductase[6]	49.80 ± 5.18	50.44 ± 5.41	+ 1	49.82 ± 4.88	0

[1] All levels are expressed as a mean ± SEM. Number of replications is 5 or 6. Mean from oil-treated mullet different from that of control mullet by *t*-test (*$p < 0.05$; **$p < 0.01$).

[2] Liver weight (g)/body weight (g) x 100.

[3] mg protein/mg wet weight.

[4] mg protein/g wet weight.

[5] Activity is expressed as nmoles cytochrome/mg total protein.

[6] Activity is expressed as mμ/mg total protein, where 1 μ is defined as 1 micromole product formed per min.

Item 99

Chromatographic analysis of fatty acid methyl esters from formulated mullet food (% of total).

Fatty Acid ID	Mullet Food
14:0	2.24
14:1	0.10
15:0	0.18
15:1	0.03
16:0	20.78
16:1	4.21
17:0	0.47
17:1	0.54
18:0	7.43
18:1	30.05
18:2	24.24
18:3	1.84
20:1	0.57
20:2	0.32
20:4	0.23
20:5	4.27
22:6	2.49

Item 100

Wet weight and fatty acid methyl ester (FAME) weight of mullet in acute mullet study.

10 PPM 96 hr	Wet Weight (gm)	FAME Weight (mg)
Mu-01-SR-1	8.59	7.80
Mu-02-SR-1	17.63	11.10
Mu-03-SR-1	5.96	4.50
Mu-04-SR-1	9.47	63.90
Mu-05-SR-1	7.96	19.30
Mu-06-SR-1	6.63	3.10
Mu-07-SR-1	10.74	6.90
Mu-08-SR-1	22.27	53.10
Mu-09-SR-1	20.16	20.00
Mu-10-SR-1	14.84	7.10
Mu-11-SR-1	10.51	9.90
Mu-12-SR-1	13.04	42.10
Mu-13-SR-1	14.42	377.00
Mu-14-SR-1	27.50	192.90
20 PPM 96 hr		
Mu-15-SR-1	10.14	11.10
Mu-16-SR-1	8.22	25.90
Mu-17-SR-1	13.08	15.60
Mu-18-SR-1	14.43	29.40
Mu-19-SR-1	7.88	26.40
Mu-20-SR-1	9.88	8.00
Mu-21-SR-1	7.61	12.10
Mu-22-SR-1	11.24	16.50
Mu-23-SR-1	10.98	35.50
Mu-24-SR-1	17.65	70.20
Mu-25-SR-1	17.55	52.00
30 PPM 96 hr		
Mu-26-SR-2	10.01	30.00
Mu-27-SR-2	7.35	31.40
Mu-28-SR-2	6.18	52.60
Mu-29-SR-2	18.58	77.10
Mu-30-SR-1	15.51	24.40
Mu-31-SR-2	12.86	35.90
Mu-32-SR-2	7.32	2.40
Mu-33-SR-2	6.83	4.90
Mu-34-SR-2	12.36	18.20
Mu-35-SR-2	13.69	15.90
Mu-59-SR-2	6.45	21.70

Item 100 (cont.)

75 PPM 96 hr	Wet Weight (gm)	FAME Weight (mg)
Mu-36-SR-2	18.00	23.70
Mu-37-SR-2	20.59	60.80
Mu-38-SR-2	9.25	35.80
Mu-39-SR-2	13.89	35.90
Mu-40-SR-2	17.16	488.70
Mu-41-SR-2	23.35	108.90
Mu-42-SR-2	7.44	8.40
Mu-43-SR-2	16.77	46.80
Control 96 hr		
Mu-46-SR-2	18.19	56.10
Mu-47-SR-2	7.83	25.50
Mu-48-SR-2	16.08	37.40
Mu-49-SR-2	6.83	27.60
Mu-50-SR-2	7.20	125.20
Mu-51-SR-2	11.20	30.60
Mu-52-SR-2	12.76	11.40
Mu-53-SR-2	21.86	46.90
Mu-54-SR-2	13.94	47.50
Mu-55-SR-2	8.16	17.70
Mu-56-SR-2	25.30	63.30
Mu-57-SR-2	11.83	219.30
Wild (10-20-73)*		
Mu-01-SR-7	18.40	244.50
Mu-02-SR-7	13.60	82.80
Mu-03-SR-7	25.70	253.50
Mu-04-SR-7	31.70	595.20
Mu-05-SR-7	35.50	521.60
Mu-06-SR-7	29.70	1730.40
Mu-07-SR-7	35.70	592.60
Mu-08-SR-7	49.50	1093.10

* Date collected from Mississippi Sound for season study.

Item 101

Fatty acid content and statistical significance of wild, aquarium control, and oil-exposed mullet. (P=0.05)

Fatty Acid ID		Control	(ppm)				
			10	20	30	75	Wild
14:0	Mean %	0.88	0.76	0.54	0.64	2.21	2.09
	Duncan*	A	A	A	A	B	B
14:1	Mean %	0.12	0.14	0.36	0.11	0.05	0.06
	Duncan	A	A	A	A	A	A
15:0	Mean %	0.86	0.61	0.70	0.51	1.61	5.43
	Duncan	A	A	A	A	A	B
15:1	Mean %	0.46	0.38	0.44	0.75	0.03	1.84
	Duncan	A	A	A	A	A	B
16:0	Mean %	19.09	16.77	15.01	19.61	27.53	18.77
	Duncan	B	BC	C	B	A	BC
16:1	Mean %	3.48	3.59	2.18	3.10	7.82	4.18
	Duncan	A	A	A	A	B	C
17:0	Mean %	1.03	1.12	0.96	0.99	1.53	1.85
	Duncan	A	A	A	A	AB	B
17:1	Mean %	1.40	1.36	1.54	1.92	1.11	5.70
	Duncan	A	A	A	A	A	B
18:0	Mean %	14.64	14.39	15.09	19.72	17.08	6.16
	Duncan	A	A	AB	A	AB	B
18:1	Mean %	18.75	19.01	16.97	23.83	16.69	5.08
	Duncan	AB	AB	AB	A	BC	B

* Means without a common letter differ significantly.

Item 101 (cont.)

Fatty Acid ID		Control	(ppm)				
			10	20	30	75	Wild
18:2	Mean %	7.82	9.15	5.61	7.28	2.13	1.64
	Duncan	A	A	AB	A	AB	B
18:3	Mean %	0.72	0.77	0.86	0.97	0.62	0.71
	Duncan	A	A	A	A	A	A
19:0	Mean %	0.68	0.75	0.88	0.82	0.87	2.32
	Duncan	A	A	A	A	A	B
20:0	Mean %	0.49	0.46	0.82	0.68	0.51	0.54
	Duncan	A	A	A	A	A	A
20:1	Mean %	0.57	0.78	0.91	0.61	0.49	1.24
	Duncan	A	A	A	A	A	A
20:2	Mean %	0.55	0.64	1.11	0.43	0.57	1.37
	Duncan	A	AB	AB	A	AB	B
20:3	Mean %	0.52	0.41	1.10	0.41	0.38	2.07
	Duncan	A	A	A	A	A	A
20:4	Mean %	6.56	6.77	8.01	5.38	3.12	4.44
	Duncan	AB	AB	A	B	B	B
20:5	Mean %	4.29	3.85	4.66	2.68	3.93	12.84
	Duncan	AB	AB	A	B	AB	C
22:1	Mean %	0.53	0.79	1.29	0.80	0.56	0.51
	Duncan	A	A	A	A	A	A
22:2	Mean %	1.46	1.59	1.22	1.45	0.33	-
	Duncan	A	A	A	A	A	A

Fatty Acid ID		Control	(ppm)				
			10	20	30	75	Wild
22:3	Mean %	1.84	1.79	3.04	1.57	0.88	1.21
	Duncan	A	A	A	A	A	A
22:4	Mean %	2.30	2.94	3.18	1.33	1.07	0.86
	Duncan	AB	A	A	AB	AB	B
22:5	Mean %	3.28	3.38	4.30	1.76	2.44	4.78
	Duncan	AB	AB	A	B	AB	A
22:6	Mean %	9.90	9.41	11.49	4.86	6.77	9.76
	Duncan	A	A	A	B	AB	A

Item 102

Wet weight and fatty acid methyl ester (FAME) weight of mullet samples in mullet season study.

Wild Mullet 5-22-73	Wet Weight (gm)	FAME Weight (mg)
Mu-03-SR-17	67.88	664.90
Mu-04-SR-17	65.26	501.50
Mu-05-SR-17	43.82	582.30
Mu-07-SR-17	85.30	426.10
Mu-09-SR-17	64.40	177.00
Mu-10-SR-17	70.90	229.30
Wild Mullet 10-20-73		
Mu-01-SR-07	18.40	244.50
Mu-02-SR-07	13.60	82.80
Mu-03-SR-07	25.70	253.50
Mu-04-SR-07	31.70	595.20
Mu-05-SR-07	35.50	521.60
Mu-06-SR-07	29.70	1730.40
Mu-07-SR-07	35.70	592.60
Mu-08-SR-07	49.50	1093.10

Item 103

Fatty acid content and statistical significance of mullet collected 5-22-73 and 10-20-73. (P=0.05)

Fatty Acid ID		5-22-73	10-20-73
14:0	Mean %	4.51**	2.09
	ANOV*	A	B
14:1	Mean %	0.14	0.06
	ANOV	A	A
15:0	Mean %	3.71	5.43
	ANOV	A	A
15:1	Mean %	0.98	1.84
	ANOV	A	A
16:0	Mean %	19.79	18.76
	ANOV	A	A
16:1	Mean %	20.93**	11.18
	ANOV	A	B
17:0	Mean %	0.96	1.85
	ANOV	A	A
17:1	Mean %	6.54	5.70
	ANOV	A	A
18:0	Mean %	4.42	6.16
	ANOV	A	A
18:1	Mean %	5.50	5.08
	ANOV	A	A

* Means without a common letter differ significantly.

** $(P < 0.01)$

Item 103 (cont.)

Fatty Acid ID		5-22-73	10-20-73
18:2	Mean %	1.60	1.64
	ANOV	A	A
18:3	Mean %	1.81**	0.56
	ANOV	A	B
18:4	Mean %	2.52	1.37
	ANOV	A	B
19:0	Mean %	1.94**	0.30
	ANOV	A	B
20:0	Mean %	1.13**	0.51
	ANOV	A	B
20:1	Mean %	0.80	1.24
	ANOV	A	A
20:2	Mean %	0.84	2.07
	ANOV	A	B
20:4	Mean %	2.74	4.44
	ANOV	A	B
20:5	Mean %	9.97	12.84
	ANOV	A	A
22:1	Mean %	0.22	0.51
	ANOV	A	A
22:2	Mean %	2.78 **	0.30
	ANOV	A	B
22:3	Mean %	1.10	1.21
	ANOV	A	A
22:4	Mean %	0.13	0.86
	ANOV	A	A
22:5	Mean %	3.11 **	4.76
	ANOV	A	B
22:6	Mean %	5.28 **	9.76
	ANOV	A	B

Item 104

Data derived from liquid chromatographic analyses of whole and/or tissue samples from mullet exposed to 75 ppm Empire Mix crude oil for periods of time up to 96 hrs. Results are in micrograms per liter.

Exposed	Condition*	Whole Fish	Carcass	Gut	Gill	Liver	Brain	Muscle
24	A	163						
24	A	118						
24	A	544						
24	A	204						
24	A	138						
24	A	172						
24	A	23						
24	A	0						
24	A	26						
24	A	0						
24	A	33						
24	A		17	152	408	286	154	
24	A		144	249	366	524		
24	A		80	67	1017	321		
24	A		127	18	1294	321		
24	A		9	3179	818	3179		
24	A		34	67	1017	321		
24	A		329	55		465		
24	A				1248	292	379	0
24	A				2159	353	0	0
24	A				395	0	0	49
24	A				115	0	0	0
24	A				0	0	0	0
24	A				171	0	0	0
24	A				128	0	0	173
24	A				0	0	2462	103
24	A				0	0	0	0

* D = Dead; A = Alive.

Item 104 (cont.)

Exposed	Condition*	Whole Fish	Carcass	Gut	Gill	Liver	Brain	Muscle
24	D		420	265				
24	D		362	205		112		
24	D		850	45		426		
24	D		906	778		1411		
48	A		8	420	250	1059	0	
48	A		28	43	115	2546	0	81
48	A		64	213	457	2540	1043	
48	A		23	481	805	1800	1043	
48	A		3	446	1516	60	1043	
48	A		30	271	347	1741	1043	
48	A		13	43	115	2546	0	81
48	A		15	43	115	2546	0	81
48	A		2048	316	1428			45
48	A		1	61	384	291	1204	98
48	A				265	0	340	0
48	A				269	0		0
48	A				791	0	0	0
48	A				1488	0	349	0
48	A				172	0	0	94
48	A				0	0	0	0
48	A				0	0		0
48	A				224	0	0	0
48	A				836	0	938	44
48	D		245	120		151		
48	D		305	769		844		
48	D		207	111				
72	A				223	244	628	78
72	A				295	141	316	63
72	A				103	391	442	0
72	A				103	137	698	0

Item 104 (cont.)

Exposed	Condition*	Whole Fish	Carcass	Gut	Gill	Liver	Brain	Muscle
72	A				95	0	0	90
72	A				106	0	0	0
72	A				469	319	0	0
72	A				77	0	0	0
72	A				8107	0	0	259
96	A		77	210	384	50	314	33
96	A		16	285	26	74	1751	81
96	A		85	571	497	0	0	56
96	A		171	161				
96	A		135	114		116		
96	A		450	179		265		
(Flushed)								
24	A				30	0	0	0
24	A				265	258	0	4
24	A				779	167	0	44
24	A				342	476	0	0
24	A				0	0	0	0
24	A				0	0	0	0
120	A				30,062	814	0	150
120	A				12,816	1032	0	0

Item 105

PER CENT OF MULLET INFECTED

Control

Test #	No. of Days Post-Spill	Conc. of Oil (mg/l)	No. of Mullet Examined	No. of Mullet Infected	% Infected
1	12	0	10	0	0
2	14	0	5	1	20
3	21	0	10	0	0
4	14	0	5	1	20
	23		5	2	40
5	21	0	10	0	0
6	21	0	5	0	0
	28		5	0	0
7*	21	0	5	1	20
	28		5	0	0
8	21	0	5	0	0
		Totals	70	5	7.1

Empire Mix Crude Oil

Test #	No. of Days Post-Spill	Conc. of Oil (mg/l)	No. of Mullet Examined	No. of Mullet Infected	% Infected
1	12	14	10	8	80
2	14	14	5	5	100
3	21	75	10	10	100
4	14	25	5	5	100
	23		5	5	100
5	21	25	10	10	100
6	21	25	5	5	100
	28		5	5	100
7*	21	25	5	5	100
	28		5	5	100
8	21	25	5	5	100
		Totals	70	68	97.1

Item 105 (cont.)

Saudi Arabian Crude Oil

Test #	No. of Days Post-Spill	Conc. of Oil (mg/l)	No. of Mullet Examined	No. of Mullet Infected	% Infected
1	12	14	10	10	100
2	14	14	5	5	100
3	21	25	10	10	100
4	14	25	5	5	100
	23		5	5	100
5	21	25	10	10	100
6	21	25	5	5	100
	28		5	5	100
7*	21	25	5	5	100
	28		5	5	100
8	21	25	5	5	100
		Totals	70	70	100

*Fish in this test were accidently subjected to a 12-hour oxygen stress.

Item 106

CHARACTERISTICS OF VIBRIO ORGANISM

Colonial Morphology - Large, round, smooth, convex, entire creamed-colored opaque colonies on TSA and TSAS

Cellular Morphology - Gram negative rods of varying lengths. Exhibit bipolar staining. Motile by means of a single polar flagellum. Non-acid fast. Non-spore former.

Biochemical and Physiological Tests:

Cytochrome oxidase	+
Lecithinase	+
Chitinase	+
Catalase	+
Glucose fermentation	Acid only
H_2S production	-
Indole	-
Gelatin liquefication	-
Methyl red	⊕ *
Vogues Proskauer	-
Nitrate reduction	+
Citrate utilization	+
Novobiocin sensitivity	+

Salt Tolerance	24 Hrs	48 Hrs
NB	⊕	+
NB (7% NaCl)	+	+
NB (10% NaCl)	-	⊕

Hemolysis

Sheep blood	+ (Beta)
Rabbit blood	+ (Beta)
Human blood	+ (Beta)

* ⊕ slightly positive

Item 107

PURE CULTURES FROM MULLET

THEIR ABILITY TO UTILIZE OIL AND DEGRADED OIL AND THEIR HEMOLYTIC CHARACTERISTICS

Culture No.*	Gram Reaction	Cellular Morphology	Hemolysis	Growth on Crude Oil After 1 Wk.	Growth on Degraded Oil After 1 Wk.	Hemolysis After Growth on Oil
1	+	Large bacilli	yes	-	-	
2	+	Bacilli	no	-	-	
3	+	Large bacilli	yes	-	-	
4	+	Large bacilli	yes	-	-	
5	-	Cocci	no	⊕	-	no
6	-	Small bacilli	no	-	-	
7	+	Bacilli	no	-	-	
8	-	Bacilli	no	⊕	-	no
9	+	Small bacilli	no	-	-	
10	+	Small bacilli	no	-	-	
11	+	Slightly curved bacilli (occurring singly)	no	-	-	
12	+	Bacilli-some w/ swollen ends	no	⊕	⊕	no
13	+	Small bacilli	no	⊕	-	no
14	+	Coccobacilli	no	⊕	⊕	no
15	+	Diplococci	no	⊕	⊕	no
16	+	Small bacilli in pairs	no	-	-	no
17	+	Cocci in tetrads	no	⊕	-	no

Item 107 (cont.)

Culture No.*	Gram Reaction	Cellular Morphology	Hemolysis	Growth on Crude Oil After 1 Wk.	Growth on Degraded Oil After 1 Wk.	Hemolysis After Growth on Oil
18	+	Large cocci	no	⊕	–	no
19	–	Cocci in tetrads	no	–	–	
20	–	Bacilli	no	–	–	
21	–	Bacilli	no	⊕	⊕	no
22	+	Coccobacilli	no	⊕	⊕	no
23	+	Cocci in clusters	no	–	–	
24	+	Cocci in tetrads	no	–	⊕	no
25	+	Coccobacilli	no	+	⊕	no
26	+	Small bacilli	no	–	–	
27	+	Large bacilli	no	–	–	
28	+	Small coccobacilli	no	–	–	
29	+	Large diplococci	no	–	–	
30	+	Small cocci	no	⊕	⊕	no
31	+	Cocci in tet.	yes	–	–	
32	+	Large bacilli some chains	no	+	⊕	no
33	+	Small bacilli	no	–	⊕	no
34	+	Long Slender bacilli	yes	–	–	
35	+	Very Large bacilli some chains	no	–	–	
36	–	Short bacilli	no	⊕	–	no
37	+	Bacilli	no	–	–	
38	–	Small bacilli	no	–	–	
39	+	Cocci in tetrads	yes	–	–	
40	–	Cocci Occurring singly	no	⊕	–	no
41	+	Cocci in tetrads	no	+	+	no

Item 107 (cont.)

Culture No.*	Gram Reaction	Cellular Morphology	Hemolysis	Growth on Crude Oil After 1 Wk.	Growth on Degraded Oil After 1 Wk.	Hemolysis After Growth on Oil
42	+	Large bacilli	no	+	+	no
43	-	Small bacilli	no	-	-	
44	+	Large bacilli some in pairs	no	-	-	
45	+	Diplococci	no	+	+	no
46	+	Diplococci	no	⊕	⊕	no
47	+	Small bacilli	no	⊕	+	no
48	+	Diplococci	no	⊕	+	no
49	-	Bacilli	no	⊕	-	no
50	-	Large curved bacilli	no	-	-	
51	-	Slender curved bacilli	no	-	-	
52**	-	Bacilli, some slightly curved	yes	⊕	⊕	yes
53	-	Bacilli	yes	-	-	no
54	-	Bacilli	no	-	-	
55	+	Large bacilli	no	-	-	
56	-	Bacilli	no	-	-	
57	+	Diplococci	no	-	-	
58	-	Bacilli	no	-	-	
59	+	Cocci in tetrads	no	-	-	
60	+	Large bacilli	no	-	-	
61	-	Bacilli	no	-	-	
62	-	Large bacilli	yes	-	-	
63	-	Bacilli	no	+	⊕	no
64	+	Bacilli	no	-	-	

+ Very turbid
⊕ Slightly turbid
* Cultures 1-37 From field study control mullet
Cultures 38-53 From field study oil-exposed mullet
Cultures 54-59 From laboratory study control mullet
Cultures 60-64 From laboratory study oil-exposed mullet
** Species of *Vibrio* (suspected pathogen)

Item 108

Relative toxicities of Empire Mix, Saudi Arabian, Nigerian, Venezuelan and Iranian crude oils to adult shrimp.

Crude Oil	Conc.	# Organisms Responding Control	# Organisms Responding Treated	% Mortalities Control	% Mortalities Treated
Empire Mix	5	0/12	0/18	0	0
	10	0/18	6/18	0	33
	15	0/27	17/30	0	56
	20	17/126	110/168	13	65
	50	0/20	20/20	0	100
	75	0/10	10/10	0	100
Saudi Arabian	10	0/6	3/12	0	25
	15	0/10	12/26	0	46
	25	0/6	5/6	0	83
Nigerian	10	1/20	9/10	10	90
	20	1/20	31/32	5	97
Venezuelan	20	1/20	1/22	5	4
	40	1/20	6/10	5	60
Iranian	20	1/20	10/24	5	42

Item 109

Shrimp Stomach-Hepatopancreas Enzymes after a 12-Hr Exposure to 8 ppm Empire Mix Crude Oil

Enzyme	Enzyme Specific Activity[a]			
	Mitochondrial[b]		Supernatant[c]	
	Control	Treated	Control	Treated
ACP	4.97 ± 1.22 (9)	5.20 ± 0.83 (12)	8.60 ± 1.25 (9)	9.78 ± 0.92 (12)
MDH	593.02 ± 125.00 (7)	609.14 ± 96.77 (12)	1.52 ± 0.24 (6)	1.41 ± 0.32 (11)
GOT	98.49 ± 17.21 (6)	86.44 ± 12.71 (11)	2.52 ± 0.79 (6)	5.84 ± 3.78 (11)
GPT	85.58 ± 18.12 (6)	76.07 ± 12.39 (11)	0.47 ± 0.09 (6)	1.34 ± 0.69 (11)
B-GLU	96.25 ± 33.29 (9)	159.02 ± 29.27 (11)	258.27 ± 71.68 (9)	325.60 ± 63.85 (12)
CYT OX	121.90 ± 12.21 (9)	123.61 ± 12.14 (12)		
CYT RED			3.13 ± 0.55 (5)	2.84 ± 0.58 (8)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] Mitochondrial fraction is defined as that portion of an 800 g/10-min supernatant sedimented at 8000 g for 15 min.

[c] Supernatant fraction is defined as the supernatant of an 8000 g/15 min centrifugation.

Item 110

Enzyme specific activity in hepatopancreas of shrimp exposed to 4 ppm emulsified Empire Mix crude oil [mean ± SE (N)].

Enzyme[2]	Fraction[3]	Specific Activity[1]		
		Control	1 day	2 days
ACP	m	9.33 ± 5.44 (3)	27.4 (1)	3.95 ± 0.05 (2)
	s	4.40 ± 1.15 (3)	1.8 (1)	4.60 ± 0.60 (2)
ALP	m	0.97 ± 0.07 (3)	2.70 ± 2.30 (2)	0.85 ± 0.45 (2)
	s	3.27 ± 1.30 (3)	4.35 ± 2.75 (2)	1.60 ± 0.60 (2)
GCPT	m	22.04 ± 5.57 (3)	12.93 ± 5.54 (2)	18.91 ± 9.61 (2)
	s	77.47 ± 11.59 (3)	67.32 ± 22.46 (2)	61.93 ± 3.63 (2)
CYT OX	m	45.63 ± 13.82 (3)	70.94 ± 54.78 (2)	80.59 ± 42.66 (2)
	s	7.52 ± 0.08 (2)	1.68 (1)	5.27 (1)
CYT RD	s	1.62 ± 0.18 (3)	3.51 ± 2.84 (2)	2.19 ± 0.53 (2)
GLU	m	491.00 ± 425.79 (3)	740.64 ± 675.10 (2)	31.71 ± 26.31 (2)
	s	139.70 ± 57.69 (3)	103.25 ± 62.25 (2)	177.68 ± 51.36 (2)
GOT	m	130.10 ± 13.79 (3)	176.76 ± 4.07 (2)	169.68 ± 58.88 (2)
	s	8.09 ± 4.30 (3)	107.38 ± 106.86 (2)	30.28 ± 27.72 (2)
GPT	m	111.05 ± 11.08 (3)	152.47 ± 24.34 (2)	152.64 ± 11.50 (2)
	s	1.75 ± 0.82 (3)	65.49 ± 64.93 (2)	10.36 ± 10.03 (2)
LAP	m	887.13 (1)	51.77 (1)	----
	s	11.16 (1)	5.75 (1)	----

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[1] Specific activity expressed as millimicromoles product formed per min per mg protein

[2] ACP = acid phosphatase; ALP = alkaline phosphatase; GCPT = ∂-glutamyl transpeptidase; CYT OX = cytochrome oxidase; CYT RD = NADPH = cytochrome c reductase; GLU = β-glucuronidase; GPT = glutamate pyruvate transaminase; LAP = leucine aminopeptidase; GOT = glutamate oxaloacetate transaminase.

[3] m = that portion of an 800 xg (10 min) supernatant sedimented at 8000 xg for 15 min

s = the supernatant of an 8000 xg (15 min) centrifugation

Effect of a one-day exposure of shrimp to 10 ppm Empire Mix crude oil on enzyme specific activities in the hepatopancreas.

	Specific Activity[1]			
	Mitochondria[2]		Supernatant	
Enzymes[3]	Control	Oil	Control	Oil
GOT	326.54 ± 52.38(10)	192.85 ± 11.99(9)	152.70 ± 11.94(10)	345.39 ± 89.60(9)
GPT	95.27 ± 8.14(10)	111.51 ± 6.12(9)	36.96 ± 8.20(10)	44.69 ± 19.54(9)
LDH	28.78 ± 5.47(10)	38.77 ± 9.34(9)	5.49 ± 2.25(10)	5.39 ± 1.67(9)
HBDH	16.32 ± 2.30(10)	20.43 ± 3.53(9)	2.75 ± 0.38(10)	2.42 ± 0.37(9)
LAP	---	---	3.44 ± 0.40(10)	2.57 ± 0.28(9)
ACP	6.35 ± 0.71(10)	6.61 ± 0.93(9)	7.25 ± 0.40(10)	6.67 ± 0.84(9)
ALP	0.98 ± 0.18(10)	1.12 ± 0.11(9)	2.14 ± 0.27(10)	1.69 ± 0.17(9)
GGTP	26.25 ± 4.45(10)	17.48 ± 5.65(9)	73.44 ± 10.65(10)	41.54 ± 4.14(9)
BGLU	144.53 ± 19.75(10)	173.94 ± 24.97(9)	349.28 ± 52.07(10)	372.70 ± 53.91(9)
CYT OX	147.61 ± 15.56(10)	145.16 ± 17.98(9)		
CYT RD	---	---	1.61 ± 0.35(9)	2.32 ± 0.34(9)

[1] Specific activity is expressed as millimicromoles of product formed per minute per milligram protein, mean ± SE (number of replications).

[2] Mitochondrial fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.

Supernatant fraction is defined as the supernatant of an 8000 g centrifugation.

[3] ACP = acid phosphatase; ALP = alkaline phosphatase; GGTP = γ-glutamyl transpeptidase; GLU = β-glucuronidase; CYT OX = cytochrome oxidase; CYT RD = NADPH - cytochrome c reductase; GOT = glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; LDH = lactic dehydrogenase; HBDH = α-hydroxybutyric dehydrogenase; LAP = leucine aminopeptidase; MDH = malic dehydrogenase.

Effect of a one-day exposure of shrimp to 10 ppm Saudi Arabian crude oil on enzyme specific activities in the hepatopancreas.

	Specific Activity[1]			
	Mitochondria[2]		Supernatant	
Enzymes[3]	Control	Oil	Control	Oil
GOT	165.46 ± 11.98(8)	159.79 ± 11.47(10)	224.50 ± 18.41(8)	412.88 ± 42.32(10)[a]
ACP	8.33 ± 1.49(8)	8.19 ± 1.01(10)	8.30 ± 0.60(8)	8.58 ± 0.65(10)
GPT	140.18 ± 23.71(6)	106.94 ± 13.56(8)	20.07 ± 3.00(6)	198.22 ± 26.95(8)[a]
ALP	2.63 ± 0.52(8)	1.89 ± 0.54(10)	4.04 ± 0.47(8)	1.86 ± 0.24(10)[a]
LDH	27.40 ± 2.50(8)	33.82 ± 2.84(10)	2.69 ± 0.74(8)	69.04 ± 43.34(10)[a]
GGTP	16.08 ± 2.55(8)	1.90 ± 0.85(10)[a]	62.57 ± 6.73(8)	15.08 ± 2.95(10)[a]
HBDH	16.80 ± 1.41(8)	24.28 ± 3.43(10)	2.86 ± 0.59(8)	28.37 ± 8.69(10)[b]
GLU	192.96 ± 24.51(6)	215.74 ± 17.99(8)	566.73 ± 50.68(8)	623.55 ± 55.40(10)
LAP	---	---	4.75 ± 0.35(8)	2.43 ± 0.23(10)[c]
CYT OX	211.83 ± 23.34(6)	172.62 ± 19.68(8)	---	---
MDH	585.59 ± 90.97(8)	682.07 ±126.21(10)	312.42 ±188.59(8)	633.83 ±205.91(10)
CYT RD	---	---	1.73 ± 0.20(8)	2.18 ± 0.25(10)

a = .001 level; b = .01 level; c = .02 level.

[1] Specific activity is expressed as millimicromoles of product formed per minute per milligram protein, mean ± SE (number of replications.

[2] Mitochondrial fraction is defined as that portion of an 800 g supernatant sedimented at 8000 g for 15 min.

Supernatant fraction is defined as the supernatant of an 8000 g centrifugation.

[3] ACP = acid phosphatase; ALP = alkaline phosphatase; GGTP = γ-glutamyl transpeptidase; GLU = β-glucuronidase; CYT OX = cytochrome oxidase; CYT RD = NADPH - cytochrome c reductase; GOT = glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; LDH = lactic dehydrogenase; HBDH = α-hydroxybutyric dehydrogenase; LAP = leucine aminopeptidase; MDH = malic dehydrogenase.

NADPH cytochrome c reductase activities in shrimp exposed to crude oil

Organism	Fraction[2]	Oil	Conc. (ppm)	Exposure Time (hr)	Specific Activity[1]	
					Control	Oil-Treated
Shrimp (hepatopancreas)	S	Empire Mix	10	24	1.61 ± 0.35(9)	2.32 ± 0.34(10)
	S	Empire Mix	8	12	2.61 ± 0.69(6)	2.85 ± 0.58(8)
	S	Saudi Arabian	10	24	1.73 ± 0.20(10)	2.18 ± 0.25(8)

---

[1] Specific activity is expressed as mU/mg protein where 1U is defined as 1 micromole product formed per minute. Activities are expressed as mean ± SEM (number of replications). Means different by *t*-test ($*p < 0.05$; $**p < 0.01$).

[2] S = supernatant of an 8000 g (15 min) centrifugation
MC = microsomal fraction, that portion of an 8000 g (15 min) supernatant sedimented at 110,000 g for 60 min.

Specific activity (mean ± SE) of various enzymes from grass shrimp when exposed to 50 ppm Empire Mix crude oil[a,b,c].

	Specific Activity[1]			
	Mitochondria[2]		Supernatant	
Enzymes[3]	Control	Oil	Control	Oil
MDH	1019.2 ± 67.8	1032.3 ± 75.1	1021.7 ± 109.6	970.6 ± 68.7
LDH	773.8 ± 40.2	768.5 ± 27.2	400.6 ± 40.6	414.8 ± 42.1
αHBDH	229.2 ± 16.7	232.5 ± 22.3	189.8 ± 30.3	213.8 ± 52.4
GPT	160.6 ± 12.8	183.2 ± 7.5	136.4 ± 13.9	145.9 ± 9.4
∂GT	4.2 ± 0.4	3.5 ± 0.4	---[d]	
CPK	37.9 ± 5.0	52.1 ± 13.4	126.8 ± 36.6	107.2 ± 32.2
LAP	1.1 ± 0.2	1.4 ± 0.1	5.6 ± 1.3	6.5 ± 1.6

[a] Activity values (mU/mg protein) based on 12 samples (three organisms pooled for each sample) for all enzymes except CPK with 9 samples.

[b] Control and treatment samples removed at time 0, 72, 144, and 264 hours.

[c] No statistical difference was observed when the data was subjected to the Student's "t" test.

[d] Activity too low to measure.

Item 115

Ratio of specific activity of supernate/mitochondria (mean ± SE) of various enzymes from grass shrimp when exposed to 50 ppm Empire Mix crude oil.

Enzymes	Control	Oil
MDH	1.1 ± 0.1	1.1 ± 0.1
LDH	2.2 ± 0.2	2.0 ± 0.2
αHBDH	1.5 ± 0.2	1.5 ± 0.2
GPT	1.3 ± 0.1	1.3 ± 0.1
CPK	0.6 ± 0.2[a]	1.0 ± 0.4[a]
LAP	0.3 ± 0.1	0.3 ± 0.1

[a] Statistical difference with $P \leq 0.05$ when analyzed by Student's "t" test.

Item 116

Chromatographic analysis of fatty acid methyl esters from formulated shrimp foods (% of total).

Fatty Acid ID	Shrimp Food
14:0	2.56
14:1	0.28
15:0	0.19
15:1	0.04
16:0	20.28
16:1	5.43
17:0	0.54
17:1	0.48
18:0	6.15
18:1	29.21
18:2	23.66
18:3	1.46
20:1	1.48
20:2	0.35
20:4	0.53
20:5	4.09
22:6	3.43

Item 117

Wet weight and fatty acid methyl ester (FAME) weight of pooled shrimp samples in shrimp acute study.

Control Muscle Tissue	Wet Weight (gm)	FAME Weight (mg)
Sh-30-AS-33 (6)*	6.80	41.70
Sh-31-AS-33 (6)	7.60	4.70
Sh-32-AS-33 (6)	9.10	1.00
Sh-33-AS-33 (6)	7.50	13.30
Sh-34-AS-33 (7)	5.90	31.60
Oiled Muscle Tissue		
Sh-35-AS-33 (5)	3.60	12.20
Sh-36-AS-33 (5)	13.20	4.80
Sh-37-AS-33 (6)	14.50	31.20
Sh-39-AS-33 (6)	15.50	20.50
Sh-40-AS-33 (7)	7.90	36.60
Sh-41-AS-33 (6)	15.10	24.90
Sh-42-AS-33 (6)	4.70	8.30
Oiled Hepatopancreas		
Sh-35-AS-32 (5)	0.10	6.10
Sh-36-AS-32 (5)	0.10	5.40
Sh-37-AS-32 (6)	0.10	20.20
Sh-38-AS-32 (6)	0.10	13.40
Sh-39-AS-32 (6)	0.20	23.20
Sh-40-AS-32 (7)	0.10	12.50
Sh-41-AS-32 (6)	0.20	26.50
Sh-42-AS-32 (6)	0.10	11.00
Sh-43-AS-32 (5)	0.20	24.80
Control Hepatopancreas		
Sh-30-AS-32 (6)	0.10	5.70
Sh-31-AS-32 (6)	0.10	7.10
Sh-32-AS-32 (6)	0.10	8.40
Sh-33-AS-32 (6)	0.10	7.00
Sh-34-AS-32 (7)	0.10	6.10

* Indicates number of organisms/sample.

Item 118

Fatty acid content and statistical significance of control shrimp tissue, oily shrimp tissue and oily shrimp guts. (P = 0.05) (15 mg/l Empire Mix crude oil)

Fatty Acid ID		Control Tissue	Oily Tissue	Oily Guts
14:0	**Mean %**	0.58	0.98	4.59
	Duncan*	A	A	B
14:1	Mean %	0.18	0.19	0.57
	Duncan	A	A	B
15:0	Mean %	0.73	0.85	1.43
	Duncan	A	A	B
15:1	Mean %	0.73	0.64	0.70
	Duncan	A	A	A
16:0	Mean %	16.95	20.10	28.67
	Duncan	A	A	B
16:1	Mean %	3.97	7.48	14.50
	Duncan	A	B	C
17:0	Mean %	2.33	2.38	1.61
	Duncan	A	A	B
17:1	Mean %	1.68	1.54	1.86
	Duncan	A	A	A
18:0	Mean %	10.69	9.86	5.27
	Duncan	A	A	B
18:1	Mean %	14.73	16.67	15.41
	Duncan	A	A	A

* Means without a common letter differ significantly.

Item 118 (cont.)

Fatty Acid ID		Control Tissue	Oily Tissue	Oily Guts
18:2	Mean %	3.62	3.77	1.83
	Duncan	A	A	B
18:3	Mean %	0.72	1.59	2.50
	Duncan	A	B	C
19:0	Mean %	0.18	0.73	0.54
	Duncan	A	A	A
20:0	Mean %	0.56	0.71	1.16
	Duncan	A	A	A
20:1	Mean %	0.79	1.03	2.52
	Duncan	A	A	B
20:2	Mean %	0.88	0.91	1.01
	Duncan	A	A	A
20:4	Mean %	7.76	6.28	3.48
	Duncan	A	A	B
20:5	Mean %	21.08	14.39	9.58
	Duncan	A	B	C
22:6	Mean %	15.63	9.92	6.82
	Duncan	A	AB	B

Item 119

Wet weight and fatty acid methyl ester (FAME) weight of pooled shrimp samples in shrimp time exposure study.

	TISSUE		GUTS	
Control 12-24 hr	Wet Wt (gm)	FAME Wt (mg)	Wet Wt (gm)	FAME Wt (mg)
Sh-096-Y-56 (3)*	11.61	3.40	0.41	1.40
Sh-100-Y-56 (1)	3.54	7.50	0.07	0.60
Sh-101-Y-56 (1)	4.54	10.50	0.14	0.60
Control 48-96 hr				
Sh-141-Y-58 (3)	7.50	0.60		
Sh-148-Y-58 (1)	2.57	2.10		
Sh-137-Y-56 (3)			0.33	0.90
2 PPM 12-24 hr				
Sh-097-Y-56 (3)	11.21	4.70	0.46	1.50
Sh-135-Y-56 (3)	11.68	23.90	0.48	1.90
2 PPM 48-96 hr				
Sh-142-Y-58 (3)	7.62	0.40	0.24	0.80
Sh-143-Y-58 (4)	10.47	7.70	0.51	2.30
4 PPM 12-24 hr				
Sh-098-Y-56 (3)	8.19	7.70	0.28	1.60
Sh-128-Y-56 (1)	2.98	8.90		
Sh-130-Y-56 (1)	2.84	8.30	0.07	0.50
Sh-134-Y-56 (3)	9.64	3.60	0.37	0.40
4 PPM 48-96 hr				
Sh-139-Y-56 (3)	8.76	3.00		
Sh-144-Y-58 (2)	4.72	1.80		
Sh-145-Y-58 (2)	6.31	4.90		
8 PPM 12-24 hr				
Sh-129-Y-56 (1)	2.33	5.00		
Sh-131-Y-56 (1)	2.53	6.30		
Sh-133-Y-56 (3)	7.42	11.00		
Sh-136-Y-56 (1)	2.19	7.00	0.08	1.20
8 PPM 48-96 hr				
Sh-138-Y-56 (3)			0.42	0.80
Sh-146-Y-58 (2)	4.85	3.90		
Sh-147-Y-58 (2)	5.40	3.60		
Sh-149-Y-58 (2)	9.33	0.90		

* Indicates number of organisms/sample.

Fatty acid content and statistical significance of shrimp muscle tissue exposed to 2, 4, and 8 ppm oil and controls for 12-24 and 48-96 hours. (P = 0.05)

Fatty Acid ID		12-24 hrs				48-96 hrs			
		Control	2PPM	4PPM	8PPM	Control	2PPM	4PPM	8PPM
14:0	Mean %	0.74	0.80	0.94	1.07	1.00	1.47	0.94	0.82
	Duncan*	A	A	A	A	A	A	A	A
14:1	Mean %	0.12	0.23	0.30	0.38	0.26	0.40	0.36	0.34
	Duncan	A	AB	AB	B	A	A	A	A
15:0	Mean %	0.68	0.77	1.20	1.29	1.11	1.35	0.94	0.97
	Duncan	A	A	A	A	A	A	A	A
15:1	Mean %	0.26	1.50	0.65	1.05	0.63	1.41	0.53	0.74
	Duncan	A	B	AC	BC	A	B	A	A
16:0	Mean %	14.92	13.24	17.59	18.37	18.53	17.54	16.77	13.98
	Duncan	A	A	A	A	A	A	A	A
16:1	Mean %	4.36	5.62	5.38	6.30	5.37	6.49	5.54	4.67
	Duncan	A	A	A	A	A	A	A	A
17:0	Mean %	2.31	2.06	3.35	3.47	3.25	2.62	3.00	2.72
	Duncan	A	A	A	A	A	A	A	A
17:1	Mean %	1.14	2.54	2.15	2.37	1.99	2.44	1.84	1.92
	Duncan	A	B	B	B	A	A	A	A
18:0	Mean %	11.61	9.33	15.11	14.08	14.64	11.38	13.56	12.07
	Duncan	A	A	A	A	A	A	A	A
18:1	Mean %	15.20	15.05	18.46	21.85	15.17	17.95	18.22	16.82
	Duncan	A	A	A	A	A	A	A	A

* Means without a common letter differ significantly.

Fatty Acid ID		12-24 hrs				48-96 hrs			
		Control	2PPM	4PPM	8PPM	Control	2PPM	4PPM	8PPM
18:2	Mean %	3.35	4.88	3.32	4.01	5.44	5.83	5.30	5.39
	Duncan	A	A	A	A	A	A	A	A
18:3	Mean %	1.25	1.54	1.72	1.10	1.40	1.08	1.31	1.19
	Duncan	A	A	A	A	A	A	A	A
19:0	Mean %	0.38	0.76	1.10	0.46	0.27	0.48	0.51	0.62
	Duncan	A	A	A	A	A	A	A	A
20:0	Mean %	0.38	0.58	0.77	0.57	0.90	0.58	0.79	0.44
	Duncan	A	AB	B	AB	A	A	A	A
20:1	Mean %	0.81	0.80	0.84	0.85	1.32	0.87	1.17	1.07
	Duncan	A	A	A	A	A	A	A	A
20:2	Mean %	0.71	1.28	0.99	0.97	1.71	1.36	1.39	1.08
	Duncan	A	A	A	A	A	A	A	A
20:3	Mean %	0.05	0.41	-	0.05	-	0.34	0.20	0.35
	Duncan	A	A	A	A	A	A	A	A
20:4	Mean %	10.27	10.72	9.33	8.66	12.80	10.29	11.13	13.39
	Duncan	A	A	A	A	A	A	A	A
20:5	Mean %	14.12	11.31	9.76	6.65	5.11	5.35	5.96	8.22
	Duncan	A	A	A	A	A	A	A	A
22:3	Mean %	1.77	1.64	0.17	0.55	1.28	1.41	1.71	1.16
	Duncan	A	A	A	A	A	A	A	A

Fatty Acid ID		12-24 hrs				48-96 hrs			
		Control	2PPM	4PPM	8PPM	Control	2PPM	4PPM	8PPM
22:4	Mean %	1.20	1.36	0.19	0.35	2.19	1.52	1.46	1.89
	Duncan	A	A	A	A	A	A	A	A
22:5	Mean %	2.28	1.57	0.22	0.73	1.65	0.92	0.81	0.97
	Duncan	A	A	A	A	A	A	A	A
22:6	Mean %	13.56	13.33	12.11	12.86	5.17	7.21	6.61	10.00
	Duncan	A	A	A	A	A	A	A	A

Fatty acid content and statistical significance of shrimp hepatopancreas exposed to 2, 4, and 8 ppm oil and controls for 12-24 and 48-96 hours. (P=0.05)

Fatty Acid ID		12-24 hrs				48-96 hrs			
		Control	2PPM	4PPM	8PPM	Control	2PPM	4PPM	8PPM
14:0	Mean %	4.17	1.77	2.26	1.29	0.60	1.05	-	4.05
	Duncan*	A	A	A	A	A	A	A	A
14:1	Mean %	0.89	0.70	1.00	0.59	0.35	0.75	-	0.35
	Duncan	A	A	A	A	A	A	A	A
15:0	Mean %	1.75	1.11	1.57	1.18	0.60	0.74	-	1.26
	Duncan	A	A	A	A	A	A	A	A
15:1	Mean %	1.27	0.93	1.80	1.06	1.21	0.97	-	0.84
	Duncan	A	A	A	A	A	A	A	A
16:0	Mean %	24.87	16.92	17.92	24.63	11.97	13.64	-	24.85
	Duncan	A	A	A	A	A	A	A	A
16:1	Mean %	7.41	6.64	7.18	7.35	5.94	6.35	-	9.51
	Duncan	A	A	A	A	A	A	A	A
17:0	Mean %	2.41	2.90	2.65	3.54	2.79	2.88	-	1.74
	Duncan	A	A	A	A	A	A	A	A
17:1	Mean %	1.62	1.94	2.55	2.48	2.62	1.81	-	1.42
	Duncan	A	A	A	A	A	A	A	A
18:0	Mean %	7.61	7.49	9.15	16.85	14.50	7.07	-	5.95
	Duncan	A	A	A	A	A	A	A	A
18:1	Mean %	13.32	17.92	16.55	27.56	19.38	15.25	-	18.43
	Duncan	A	AB	AB	B	A	A	A	A

* Means without a common letter differ significantly.

Fatty Acid ID		12-24 hrs				48-96 hrs			
		Control	2PPM	4PPM	8PPM	Control	2PPM	4PPM	8PPM
18:2	Mean %	2.22	3.71	3.17	5.05	3.88	2.73	-	3.88
	Duncan	A	AB	AB	B	A	A	A	A
18:3	Mean %	1.82	6.32	3.52	0.87	0.87	1.43	-	0.87
	Duncan	A	A	A	A	A	A	A	A
20:0	Mean %	0.74	1.28	1.07	1.46	0.84	0.82	-	1.27
	Duncan	A	A	AB	B	A	A	A	A
20:1	Mean %	5.62	1.34	1.21	2.30	1.89	6.24	-	3.07
	Duncan	A	AB	B	AB	A	A	A	A
20:2	Mean %	2.15	2.99	3.12	1.20	1.96	2.72	-	2.43
	Duncan	A	A	A	A	A	A	A	A
20:4	Mean %	5.42	6.02	9.99	1.05	13.62	5.39	-	7.09
	Duncan	A	A	A	A	A	A	A	A
20:5	Mean %	8.17	6.49	2.04	0.70	7.61	20.25	-	7.54
	Duncan	A	A	A	A	A	A	A	A
22:3	Mean %	1.58	2.81	7.11	-	-	-	-	-
	Duncan	A	A	A	A	A	A	A	A
22:4	Mean %	1.88	1.61	1.04	-	-	-	-	-
	Duncan	A	A	A	A	A	A	A	A
22:5	Mean %	1.08	2.58	1.19	-	-	-	-	-
	Duncan	A	A	A	A	A	A	A	A
22:6	Mean %	6.41	12.43	10.69	-	7.05	3.85	-	7.05
	Duncan	A	A	A	A	A	A	A	A

Fatty acid content and statistical significance of shrimp muscle tissue exposed to 2, 4, and 8 ppm oil for 12-24 and 48-96 hours. (P=0.05)

Fatty Acid ID		2PPM		4PPM		8PPM	
		12-24 hrs	48-96 hrs	12-24 hrs	48-96 hrs	12-24 hrs	48-96 hrs
14:0	Mean %	0.80	1.47	0.94	0.94	1.06	0.82
	ANOV*	A	A	A	A	A	A
14:1	Mean %	0.23	0.40	0.30	0.36	0.38	0.34
	ANOV	A	A	A	A	A	A
15:0	Mean %	0.77	1.35	1.29	0.94	1.20	0.97
	ANOV	A	A	A	A	A	A
15:1	Mean %	1.50	1.41	0.65	0.53	1.05	0.74
	ANOV	A	A	A	A	A	A
16:0	Mean %	13.24	17.54	17.59	16.77	18.37	13.98
	ANOV	A	A	A	A	A	A
16:1	Mean %	5.62	6.49	5.38	5.54	6.30	4.67
	ANOV	A	A	A	A	A	A
17:0	Mean %	2.06	2.62	3.35	3.00	3.47	2.72
	ANOV	A	A	A	A	A	A
17:1	Mean %	2.54	2.44	2.15	1.84	2.37	1.92
	ANOV	A	B	A	A	A	B
18:0	Mean %	9.33	11.38	15.11	13.57	14.08	12.07
	ANOV	A	B	A	A	A	A
18:1	Mean %	15.05	17.95	18.47	18.22	21.58	16.82
	ANOV	A	A	A	A	A	A

* Means without a common letter differ significantly.

Item 122 (cont.)

Fatty Acid ID		2PPM		4PPM		8PPM	
		12-24 hrs	48-96 hrs	12-24 hrs	48-96 hrs	12-24 hrs	48-96 hrs
18:2	Mean %	5.83	4.88	3.32	5.30	4.01	5.39
	ANOV	A	A	A	A	A	A
18:3	Mean %	1.54	1.08	1.72	1.31	1.10	1.19
	ANOV	A	A	A	A	A	A
19:0	Mean %	0.25	0.24	0.37	0.51	0.46	0.21
	ANOV	A	A	A	A	A	A
20:0	Mean %	0.58	0.51	0.51	0.79	0.57	0.29
	ANOV	A	A	A	A	A	A
20:1	Mean %	0.80	0.87	0.84	1.17	0.43	1.07
	ANOV	A	A	A	A	A	A
20:2	Mean %	1.28	1.36	0.66	1.39	0.73	1.08
	ANOV	A	A	A	A	A	A
20:3	Mean %	0.14	0.34	0.00	0.13	0.01	0.12
	ANOV	A	A	A	A	A	A
20:4	Mean %	10.72	10.29	9.33	11.13	8.66	13.39
	ANOV	A	A	A	A	A	A
20:5	Mean %	11.31	5.35	9.76	5.96	6.65	8.22
	ANOV	A	A	A	A	A	A
22:3	Mean %	1.09	1.41	0.06	1.71	0.28	1.16
	ANOV	A	A	A	B	A	B
22:4	Mean %	1.37	1.52	0.06	1.46	0.19	1.87
	ANOV	A	A	A	B	A	B
22:5	Mean %	1.57	0.92	0.07	0.80	0.36	0.97
	ANOV	A	A	A	A	A	A
22:6	Mean %	13.33	7.21	7.35	8.07	6.43	10.00
	ANOV	A	A	A	A	A	A

Item 123

Concentration of oil in shrimp tissues obtained from tests in which shrimp were exposed to 15 and 20 ppm Empire Mix crude oil for 12 to 90 hrs.

Sample	#†	Oil in Tank (ppm)	Exposure Time (hrs)	Total Oil (μg)	
				LC	GC
SH-30-AS-32 - HP	6	Control	90	-	11.7
SH-31-AS-32 - HP	6	Control	90	-	No-C16
SH-32-AS-32 - HP	6	Control	90	-	244.0
SH-33-AS-32 - HP	6	Control	90	-	No-C16
SH-34-AS-32 - HP	7	Control	90	-	37.6
SH-35-AS-32 - HP	5	20	90	100	No-C16
SH-36-AS-32 - HP	5	15	90	350	No-C16
SH-37-AS-32 - HP	6	15	12	437	11.2
SH-38-AS-32 - HP	6	15	12	150	14.3
SH-39-AS-32 - HP	6	15	12	375	14.3
SH-40-AS-32 - HP	7	15	12	200	No-C16
SH-41-AS-32 - HP	6	15	90	175	No-C16
SH-42-AS-32 - HP	6	15	90	385	No-C16
SH-43-AS-32 - HP	5	15	90	450	15.7
SH-30-AS-33 - HP	6	Control	90	-	49.2
SH-31-AS-33 - Muscle	6	Control	90	-	No-C16
SH-32-AS-33 - Muscle	6	Control	90	-	No-C16
SH-33-AS-33 - Muscle	6	Control	90	-	No-C16
SH-34-AS-33 - Muscle	7	Control	90	-	75.5
SH-35-AS-33 - Muscle	5	20	90	-	39.0
*SH-36-AS-33 - Muscle	5	15	90	1640	164.3
*SH-37-AS-33 - Muscle	6	15	12	3270	No-C16
*SH-38-AS-33 - Muscle	6	15	12	2320	74.5
*SH-39-AS-33 - Muscle	6	15	12	3450	16.9
SH-40-AS-33 - Muscle	7	15	12	175	198.6
SH-41-AS-33 - Muscle	6	15	90	1250	39.0
SH-42-AS-33 - Muscle	6	15	90	2010	No-C16
SH-42-AS-33 - Muscle	5	15	90	1900	103.1

† Number of organisms used

* Saponified over weekend

Item 124

Concentration of oil in shrimp tissues obtained from tests in which shrimp were exposed 2, 4 and 8 ppm for 12-96 hrs.

Sample	#[†]	Oil in Tank (ppm)	Exposure Time (hrs)	Condition[††]	Total Oil (µg)	
					LC	GC
SH-96-Y-56 - Muscle	3	Control	12	S	-	Con.[∇]
SH-96-Y-56 - HP	3	Control	12	S	-	-
SH-97-Y-56 - Muscle	3	2	12	S	1620	11.9
SH-97-Y-56 - HP	3	2	12	S	475	-
SH-98-Y-56 - Muscle	3	4	12	S	2120	64.0
SH-98-Y-56 - HP	3	4	12	S	613	-
SH-99-Y-56 - Muscle	3	8	12	S	4250	36.4
SH-99-Y-56 - HP	3	8	12	S	400	-
SH-100-Y-56 - Muscle	3	Control	12	D	-	No-C16
SH-100-Y-56 - HP	3	Control	12	D	-	-
SH-101-Y-56 - Muscle	3	Control	12	D	-	Con.
SH-101-Y-56 - HP	3	Control	12	D	-	-
SH-128-Y-56 - Muscle	1	4	18	D	1620	21.7
SH-128-Y-56 - HP	1	4	18	D	400	-
SH-129-Y-56 - Muscle	1	4	18	D	1370	No-C16
SH-129-Y-56 - HP	1	4	18	D	150	-
SH-130-Y-56 - Muscle	1	8	18	D	3130	41.5
SH-130-Y-56 - HP	1	8	18	D	312	-
SH-131-Y-56 - Muscle	1	8	18	D	3500	20.4
SH-131-Y-56 - HP	1	8	18	D	560	-
SH-132-Y-56 - Muscle	3	Control	24	S	-	41.5
SH-132-Y-56 - HP	3	Control	24	S	-	-
SH-133-Y-56 - Muscle	3	8	24	S	6.6	1.1
SH-133-Y-56 - HP	3	8	24	S	-	-
SH-134-Y-56 - Muscle	3	4	24	S	4.8	2.4
SH-134-Y-56 - HP	3	4	24	S	8.1	3.3
SH-135-Y-56 - Muscle	3	2	24	S	4.7	2.1
SH-135-Y-56 - HP	3	2	24	S	6.0	5.3
SH-136-Y-56 - Muscle	1	8	24	D	8.3	0.8
SH-136-Y-56 - HP	1	8	24	D	7.4	0.9
H-137-Y-56 - Muscle	3	Control	48	S	-	-
SH-137-Y-56 - HP	3	Control	48	S	5.9	0.9
SH-138-Y-56 - Muscle	3	8	48	S	-	-
SH-138-Y-56 - HP	3	8	48	S	9.5	0.8
SH-139-Y-56 - Muscle	3	4	48	S	6.7	1.2
SH-139-Y-56 - HP	3	4	48	S	-	-
SH-140-Y-56 - Muscle	3	2	48	S	-	-
SH-140-Y-56 - HP	3	2	48	S	-	-

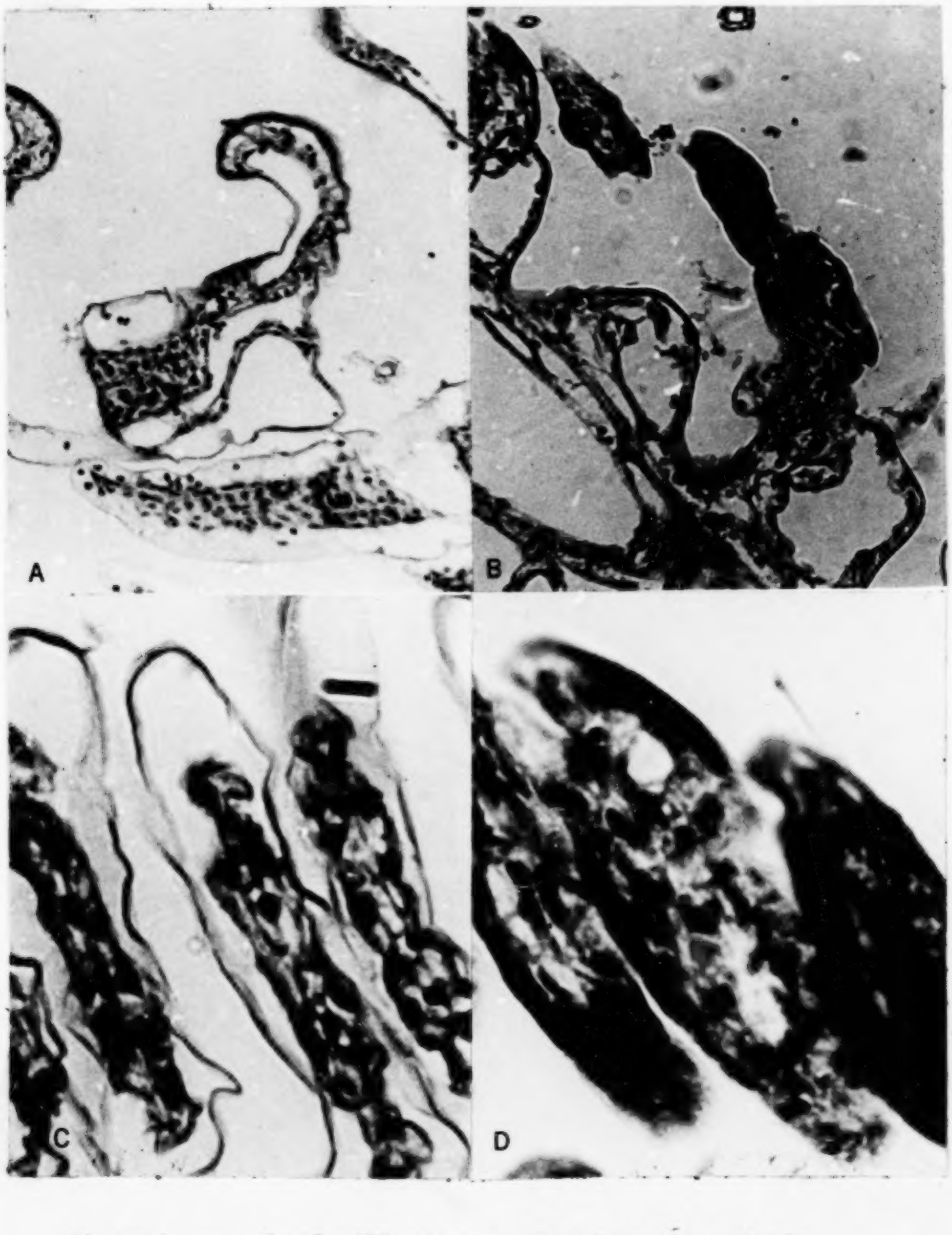
Item 124 (cont.)

Sample	#[†]	Oil in Tank (ppm)	Exposure Time (hrs)	Condition[††]	Total Oil (μg) LC	Total Oil (μg) GC
SH-141-Y-56 - Muscle	3	Control	96	S	6.9	0.7
SH-141-Y-56 - HP	3	Control	96	S	-	-
SH-142-Y-56 - Muscle	3	2	96	S	9.1	1.1
SH-142-Y-56 - HP	3	2	96	S	7.0	1.5
SH-143-Y-56 - Muscle	4	2	96	S	3.9	1.1
SH-143-Y-56 - HP	4	2	96	S	5.7	1.3
SH-144-Y-56 - Muscle	2	4	96	S	5.4	1.4
SH-144-Y-56 - HP	2	4	96	S	-	-
SH-145-Y-56 - Muscle	2	4	96	S	4.5	1.3
SH-145-Y-56 - HP	2	4	96	S	-	-
SH-146-Y-56 - Muscle	2	8	96	S	5.1	1.2
SH-146-Y-56 - HP	2	8	96	S	-	-
SH-147-Y-56 - Muscle	2	8	96	S	4.2	1.1
SH-147-Y-56 - HP	2	8	96	S	-	-
SH-148-Y-56 - Muscle	1	Control	96	S	3.8	1.4
SH-148-Y-56 - HP	1	Control	96	S	-	-
SH-149-Y-56 - Muscle	2	8	96	S	4.7	1.3
SH-149-Y-56 - HP	2	8	96	S	-	-

† Number of organisms used

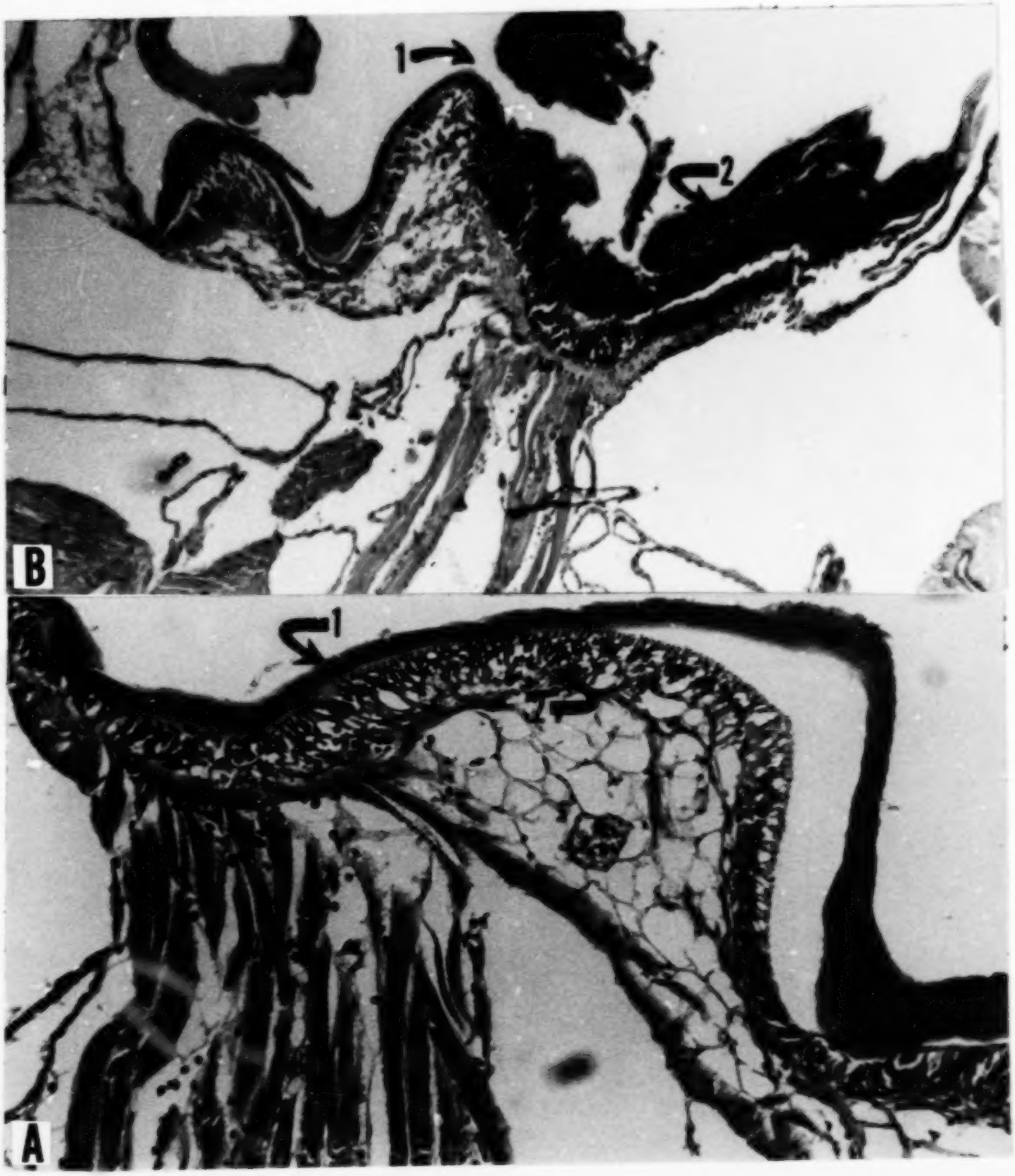
†† Condition: D - Dead
S - Sacrificed

∇ Con. - Contamination



Photomicrograph of gill tissue. Sections through the branchiostegial region: A--control; B--oil-exposed. Sections through individual lamellae: C--control; D--oil-exposed.

Item 126



Photomicrograph of a x-section of the esophageal region. A--normal tissue: (1) chitinous cover (2) normal epithelium and loose connective tissue. B--tissue from oil-exposed shrimp: (1) disrupted chitinous layer (2) lesions filled with fibrocytic type cells.

Item 127

Relative 96 hr toxicities of Empire Mix, Saudi Arabian, Venezuelan and Iranian crude oils to oysters.*

		# Organisms Responding		% Mortalities	
Crude Oil	Conc.	Control	Treated	Control	Treated
Empire Mix	500	0/20	0/20	0	0
	600	0/20	0/20	0	0
	800	0/20	0/20	0	0
	1000	0/20	0/20	0	0
Saudi Arabian	400	0/40	0/40	0	0
Nigerian	400	0/20	0/20	0	0
Venezuelan	400	0/20	0/20	0	0
Iranian	400	0/20	0/20	0	0

*Extensive acute toxicity tests were not conducted with oysters due to their obvious ability to close during short-term exposure to high concentrations of oil.

Item 128

Enzyme Levels in the Oyster Treated with 75 ppm Empire Mix Crude Oil

Enzyme	Fraction[b]	Specific Activity[a]			
		Control	2 Day	4 Day	7 Day
ACHE	SS	6.74 ± 0.36 (35)	7.40 ± 0.44 (22)	7.67 ± 0.64 (18)	6.19 ± 0.40 (25)
ACP	SS	17.48 ± 1.17 (36)	20.27 ± 1.44 (22)	16.00 ± 1.90 (19)	18.53 ± 1.32 (25)
ALP	SS	1.26 ± 0.12 (35)	1.00 ± 0.15 (22)	0.92 ± 0.19 (19)	1.09 ± 0.14 (24)
CYT OX	M	6.82 ± 1.96 (19)		6.94 ± 1.71 (15)	6.95 ± 1.21 (15)
GOT	M	68.80 ± 18.01 (21)	61.54 ± 18.94 (19)	52.22 ± 36.79 (6)	124.94 ± 22.06 (4)
GOT	S	70.90 ± 4.42 (18)	78.73 ± 3.97 (19)	63.73 ± 7.76 (6)	77.61 ± 4.90 (13)
LAP	M	13.89 ± 0.93 (17)	11.49 ± 0.82 (6)	14.22 ± 0.89 (15)	13.01 ± 0.90 (11)
MDH	S	1665.57 ± 357.28 (23)	1334.56 ± 329.40 (15)	2377.73 ± 411.21 (15)	2077.11 ± 366.50 (17)

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] M fraction is defined as that portion of an 800 g/10-min supernatant sedimented at 8000 g for 15 min.
S fraction is defined as the supernatant from an 8000 g/15-min centrifugation.
SS fraction is defined as the supernatant of a 110,000 g/30-min centrifugation of a homogenate which had been sonified at 35 w for 0.5 min.

Item 129

Enzyme Levels in Oyster Treated with 75 ppm Empire Mix Crude Oil

Enzyme	Fraction[b]	Specific Activity[a]			
		Control	2 Day	4 Day	7 Day
B-GLU	SS	958.05 ± 82.99 (23)	1275.21 ± 114.25 (11)	1370.97 ± 112.35 (15)	848.18 ± 148.10 (17)[c]
GPT	M	34.31 ± 3.09 (27)	39.00 ± 3.68 (19)	26.45 ± 7.74 (13)	58.94 ± 7.26 (21)[c]
GPT'	S	39.58 ± 2.51 (26)	51.20 ± 2.36 (19)	37.74 ± 3.17 (15)	40.91 ± 2.58 (20)[d]
LAP	S	421.92 ± 74.14 (21)	160.37 ± 69.95 (14)	501.79 ± 76.52 (15)	312.84 ± 71.39 (17)[e]
MDH	M	440.00 ± 36.54 (22)	326.05 ± 30.38 (15)	341.11 ± 38.13 (15)	468.21 ± 34.03 (17)[f]

[a] Specific activity is expressed as millimicromoles of product formed/min/mg protein, mean ± SE. Number in parentheses is number of replications.

[b] M fraction is defined as that portion of an 800 g/10-min supernatant sedimented at 8000 g for 15 min.
S fraction is defined as the supernatant from an 8000 g/15-min centrifugation.
SS fraction is defined as the supernatant of a 110,000 g/30-min centrifugation of a homogenate which had been sonified at 35 w for 0.5 min.

[c] 4-day treatment mean significantly different from 7-day treatment mean ($P < 0.05$).

[d] 2-day treatment mean significantly different from 4- and 7-day treatment means ($P < 0.05$).

[e] 2-day treatment mean significantly different from 4-day treatment mean ($P < 0.05$).

[f] Control and 7-day treatment means significantly different from 2- and 4-day treatment means ($P < 0.05$).

Specific activities from oysters exposed to a surface film of 100 ppm Empire Mix Crude Oil daily for 7 days and sampled at time intervals following cessation of oil additions.

	Specific activity			
	GOT[2]		GPT	
Time[3]	m[4]	s[5]	m	s
Control	86.6 ± 5.8(11)* 46.3 - 112.4	121.1 ± 5.2(11) 93.0 - 151.4	54.0 ± 8.6(9) 27.8 - 109.4	33.4 ± 3.2(9) 23.2 - 50.4
2 da	125.7 ± 12.9(2) 112.8 - 138.6	135.6 ± 6.1(2) 129.6 - 141.7	101.8 ± 9.4(2) 92.4 - 111.3	77.2 ± 39.8(2) 37.5 - 117.0
3 da	75.6 ± 7.2(3) 67.3 - 89.8	132.3 ± 6.3(3) 115.7 - 140.7	45.5 ± 5.4(3) 34.8 - 51.2	28.5 ± 4.6(3) 21.3 - 37.0
4 da	93.9 ± 32.1(4) 57.8 - 190.1	111.8 ± 7.3(4) 97.7 - 128.0	32.4 ± 2.9(4) 26.8 - 36.4	37.2 ± 7.7(4) 25.3 - 59.8
5 da	81.4 ± 6.2(6) 56.1 - 101.1	105.1 ± 4.3(6) 88.2 - 115.7	60.8 ± 6.2(6) 47.7 - 90.3	27.6 ± 3.6(6) 14.8 - 41.1
7 da	91.0 ± 6.3(4) 73.1 - 102.2	124.4 ± 8.1(4) 108.2 - 138.8	46.5 ± 4.5(4) 38.1 - 58.3	36.3 ± 7.9(4) 18.8 - 45.5
8 da	98.6 ± 12.0(4) 66.2 - 124.3	114.6 ± 17.6(4) 88.1 - 166.5	- - - -	- - - -

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[1] Specific activity is expressed as millimicromoles substrate formed per minute per mg protein, mean ± SE (number of replications) and range.

[2] GOT = glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; LAP = leucine aminopeptidase; CPK = creatine phosphokinase.

[3] days after cessation of oil exposures.

[4] m = mitochondrial fraction, that portion of an 800 g (10 min) supernatant sedimented at 8000 g (15 min)

[5] s = supernatant fraction, supernatant of an 8000 g (15 min) centrifugation.

* No. in ( ) = Number of oysters in sample.

Time[3]	Specific activity			
	LAP[2]		CPK	
	m[4]	s[5]	m	s
Control	23.0 ± 2.6(11) 14.0 - 40.8	163.5 ± 19.3(11) 91.1 - 298.2	0.00	29.8 ± 4.4(9) 17.4 - 52.8
2 da	45.6 ± 7.0(2) 38.6 - 52.5	161.5 ± 78.5(2) 83.0 - 240.0	0.00	34.8 ± 13.9(2) 20.9 - 48.7
3 da	20.8 ± 2.5(3) 16.3 - 25.0	115.7 ± 11.4(3) 92.0 - 128.1	0.00	22.2 ± 3.8(3) 18.3 - 29.8
4 da	24.8 ± 2.6(3) 19.9 - 29.0	155.2 ± 14.6(4) 120.5 - 180.3	0.00	30.8 ± 2.6(4) 23.5 - 35.4
5 da	38.2 ± 5.5(6) 24.2 - 55.2	153.0 ± 7.8(6) 125.2 - 177.7	0.00	20.2 ± 3.2(6) 12.3 - 35.2
7 da	32.0 ± 2.1(3) 29.3 - 36.1	130.2 ± 19.4(4) 91.7 - 177.2	0.00	21.1 ± 3.6(4) 15.4 - 31.5
8 da	39.2 ± 6.9(4) 21.0 - 54.3	132.8 ± 14.5(4) 98.4 - 169.2	--	-----

[1] Specific activity is expressed as millimicromoles substrate formed per minute per mg protein, mean ± SE (number of replications) and range.

[2] GOT = glutamic oxaloacetic transaminase; GPT = glutamic pyruvic transaminase; LAP = leucine aminopeptidase; CPK = creatine phosphokinase.

[3] days after cessation of oil exposures.

[4] m = mitochondrial fraction, that portion of an 800 g (10 min) supernatant sedimented at 8000 g (15 min)

[5] s = supernatant fraction, supernatant of an 8000 g (15 min) centrifugation.

* No. in ( ) = Number of oysters in sample.

Item 131

The effect on enzymes of a four day exposure of oysters to 75 ppm Saudi Arabian Crude Oil.

Enzyme[2]	Fraction[3]	Specific Activity[1]	
		Control	Oil
ACP	ss	3.9 ± 0.4	4.0 ± 0.3
ALP	ss	1.0 ± 0.1	1.1 ± 0.1
CHE	ss	2.8 ± 0.3	3.0 ± 0.3
CYT OX	m	46.7 ± 4.9	67.0 ± 12.4
CYT RD	s	2.2 ± 0.2	2.6 ± 0.3
	ss	1059.6 ± 92.9	1145.4 ± 180.2
GPT	m	44.8 ± 9.3	52.5 ± 4.9
	s	34.8 ± 3.1	29.8 ± 2.4
GOT	m	68.3 ± 2.7	68.9 ± 4.8
	s	123.2 ± 11.8	108.1 ± 6.5
LAP	m	62.7 ± 5.1	60.6 ± 5.2
	s	157.1 ± 11.3	162.9 ± 9.4
MDH	m	573.0 ± 21.7	590.4 ± 25.6
	s	1758.5 ± 79.1	1684.5 ± 60.0

[1] Specific activity is expressed as millimicromoles product formed per minute per mg protein, mean ± SE. In most cases, 10 replicates contribute to each mean.

[2] ACP = acid phosphatase; ALP = alkaline phosphatase; CHE = acetylcholinesterase; CYT OX = cytochrome oxidase; CYT RD = NADPH - cytochrome c reductase; GLU = β - glucuronidase; GPT = glutamic pyruvic transaminase; GOT = glutamic oxaloacetic transaminase; LAP = leucine aminopeptidase; MDH = malic dehydrogenase.

[3] m = mitochondrial fraction, that portion of an 800 g (10 min) supernatant sedimented at 8000 g for 15 min.
s = supernatant fraction, the supernatant of an 8000 g (15 min) centrifugation.
ss = sonified soluble fraction, the supernatant of a 110,000 g (30 min) centrifugation of a homogenate which had been sonified at 35 W for 0.5 min.

Effect of a four day exposure of oysters to 75 ppm Emulsified Crude Oil on enzyme specific activities.

Enzyme (F)	Specific Activity			
	Control	Nigerian	Iranian	Venezuelan
GOT S	66.1 ± 3.0(31)*	49.1 ± 2.9(10)[a]	63.3 ± 4.3(11)	66.4 ± 5.2(10)
M	66.6 ± 2.8(31)	65.9 ± 5.9(10)	70.0 ± 5.2(11)	56.1 ± 4.3(10)
GPT S	25.2 ± 1.4(31)	19.4 ± 2.4(10)[c]	20.8 ± 1.4(11)	28.2 ± 3.73(10)
M	39.0 ± 2.2(31)	39.8 ± 3.0(10)	49.0 ± 3.8(11)[c]	40.0 ± 3.9(10)
LAP S	105.1 ± 6.1(31)	67.9 ± 6.0(10)[b]	80.8 ± 6.4(11)[c]	126.7 ± 8.8(10)
M	60.8 ± 4.5(31)	47.1 ± 4.6(10)	63.2 ± 6.7(11)	57.4 ± 4.4(10)
MDH S	1470.0 ± 61.4(31)	1393.7 ± 72.2(10)	1271.1 ± 121.6(11)	- - - - -
M	633.4 ± 57.3(31)	500.1 ± 26.5(10)	669.8 ± 68.4(11)	- - - - -
ACP SS	5.4 ± 0.3(5)	6.1 ± 0.5(5)	- - - - -	- - - - -
ALP SS	0.6 ± 0.0(5)	0.6 ± 0.1(5)	- - - - -	- - - - -
ACHE SS	2.1 ± 0.1(9)	2.1 ± 0.1(10)	- - - - -	- - - - -
BGLU SS	473.5 ± 54.2(5)	473.7 ± 77.8(5)	- - - - -	- - - - -
CYT RD S	0.9 ± 0.4(10)	1.8 ± 0.2(10)	- - - - -	- - - - -
S	3.7 ± 0.3(10)	- - - - -	3.8 ± 0.2(12)	- - - - -
S	3.9 ± 0.4(10)	- - - - -	- - - - -	4.1 ± 0.7(10)
CYT OX M	17.6 ± 6.4(5)	15.9 ± 6.0(5)	- - - - -	- - - - -
M	25.3 ± 7.9(5)	- - - - -	23.4 ± 5.1(5)	- - - - -
M	13.8 ± 2.2(9)	- - - - -	- - - - -	11.3 ± 1.6(10)

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* = No. in ( ) = No. of oysters in sample.

a = .001 level.

b = .01 level.

c = .02 level.

NADPH cytochrome c reductase activities in oysters exposed to crude oil.

Organism	Fraction[2]	Oil	Conc., ppm	Exposure time, hr	Specific Activity[1]	
					Control	Oil-Treated
Oyster	MC	Empire Mix	75	96	1.55±1.13(4)	12.21±1.56(4)**
	S	Saudi Arabian	75	96	2.18±0.17(10)	2.63±0.32(10)
	S	Venezuelan	75	96	3.89±0.39(10)	4.11±0.73(10)
	S	Nigerian	75	96	0.87±0.37(10)	1.85±0.22(10)*
	S	Iranian	75	96	3.72±0.29(10)	3.79±0.18(12)

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[1] Specific activity is expressed as mμ/mg protein where 1μ is defined as 1 micromole product formed per minute. Activities are expressed as mean ± SEM (number of replications). Means different by *t* - test (*P <0.05; **P <0.01).

[2] S = supernatant of an 8000 g (15 min) centrifugation
MC = microsomal fraction, that portion of an 8000 g (15 min) supernatant sedimented at 111,000 g for 60 min.

Item 134

Wet weight and fatty acid methyl ester (FAME) weight of oyster samples in acute oyster study.

Control 24 hr	Wet Weight (gm)	FAME Weight (mg)
Oy-01-Y-26 (1)*	9.19	119.90
Oy-02-Y-26 (1)	15.40	159.00
Oy-03-Y-26 (1)	9.90	157.11
Oy-04-Y-26 (1)	5.57	140.50
75 PPM 24 hr		
Oy-05-Y-26 (2)	6.65	57.60
Oy-06-Y-26 (1)	5.80	1.80
Oy-17-Y-26 (1)	7.81	129.60
Oy-19-Y-26 (2)	5.62	49.10
Oy-22-Y-26 (1)	10.07	157.80
Control 72 hr		
Oy-43-Y-26 (1)	6.87	92.00
Oy-44-Y-26 (2)	9.51	104.80
Oy-45-Y-26 (1)	5.09	64.50
Oy-46-Y-26 (1)	6.43	81.40
Oy-47-Y-26 (1)	5.58	20.30
Oy-48-Y-26 (1)	14.42	214.10
Oy-49-Y-26 (1)	7.61	72.80
75 PPM 72 hr		
Oy-12-Y-26 (1)	10.84	50.20
Oy-50-Y-26 (2)	5.56	20.10
Oy-51-Y-26 (1)	9.58	40.70
Oy-52-Y-26 (1)	8.12	46.40
Oy-53-Y-26 (1)	22.74	202.30
Oy-54-Y-26 (1)	9.55	204.70
Oy-55-Y-26 (1)	7.75	24.20
Oy-56-Y-26 (1)	15.40	53.70
Oy-57-Y-26 (1)	10.11	99.80
Oy-58-Y-26 (1)	8.06	26.20

* Indicates number of organisms/sample.

Item 135

Fatty acid content and statistical significance of control and oil exposed oysters for 24 and 72 hours. (P=0.05)

Fatty Acid ID		24 hrs		72 hrs	
		Control	75 PPM	Control	75 PPM
14:0	Mean %	3.12	3.68	2.95	2.98
	Duncan*	A	A	A	A
14:1	Mean %	0.18	0.26	0.20	0.21
	Duncan	A	A	A	A
15:0	Mean %	0.75	0.98	0.89	0.90
	Duncan	A	A	A	A
15:1	Mean %	0.12	0.17	0.15	0.15
	Duncan	A	A	A	A
16:0	Mean %	26.81	32.27	30.82	28.54
	Duncan	A	A	A	A
16:1	Mean %	5.75	6.37	5.33	5.41
	Duncan	A	A	A	A
17:0	Mean %	1.58	1.71	1.67	1.70
	Duncan	A	A	A	A
17:1	Mean %	0.68	0.76	0.93	1.06
	Duncan	A	AB	AB	B
18:0	Mean %	3.70	4.26	4.39	4.63
	Duncan	A	A	A	A
18:1	Mean %	8.08	8.56	8.35	8.31
	Duncan	A	A	A	A

* Means without a common letter differ significantly.

Item 135 (Cont.)

Fatty Acid ID		24 hrs		72 hrs	
		Control	75 PPM	Control	75 PPM
18:2	Mean %	3.04	3.49	3.36	3.54
	Duncan	A	A	A	A
18:3	Mean %	4.59	3.88	3.76	3.73
	Duncan	A	A	A	A
18:4	Mean %	7.16	5.61	6.47	5.86
	Duncan	A	A	A	A
20:1	Mean %	3.81	3.85	4.17	4.49
	Duncan	A	A	A	A
20:4	Mean %	1.88	1.84	1.75	1.94
	Duncan	A	A	A	A
20:5	Mean %	11.75	7.95	9.07	9.52
	Duncan	A	A	A	A
22:1	Mean %	4.49	4.27	5.17	5.48
	Duncan	AB	A	AB	B
22:6	Mean %	12.51	10.09	10.45	11.00
	Duncan	A	A	A	A

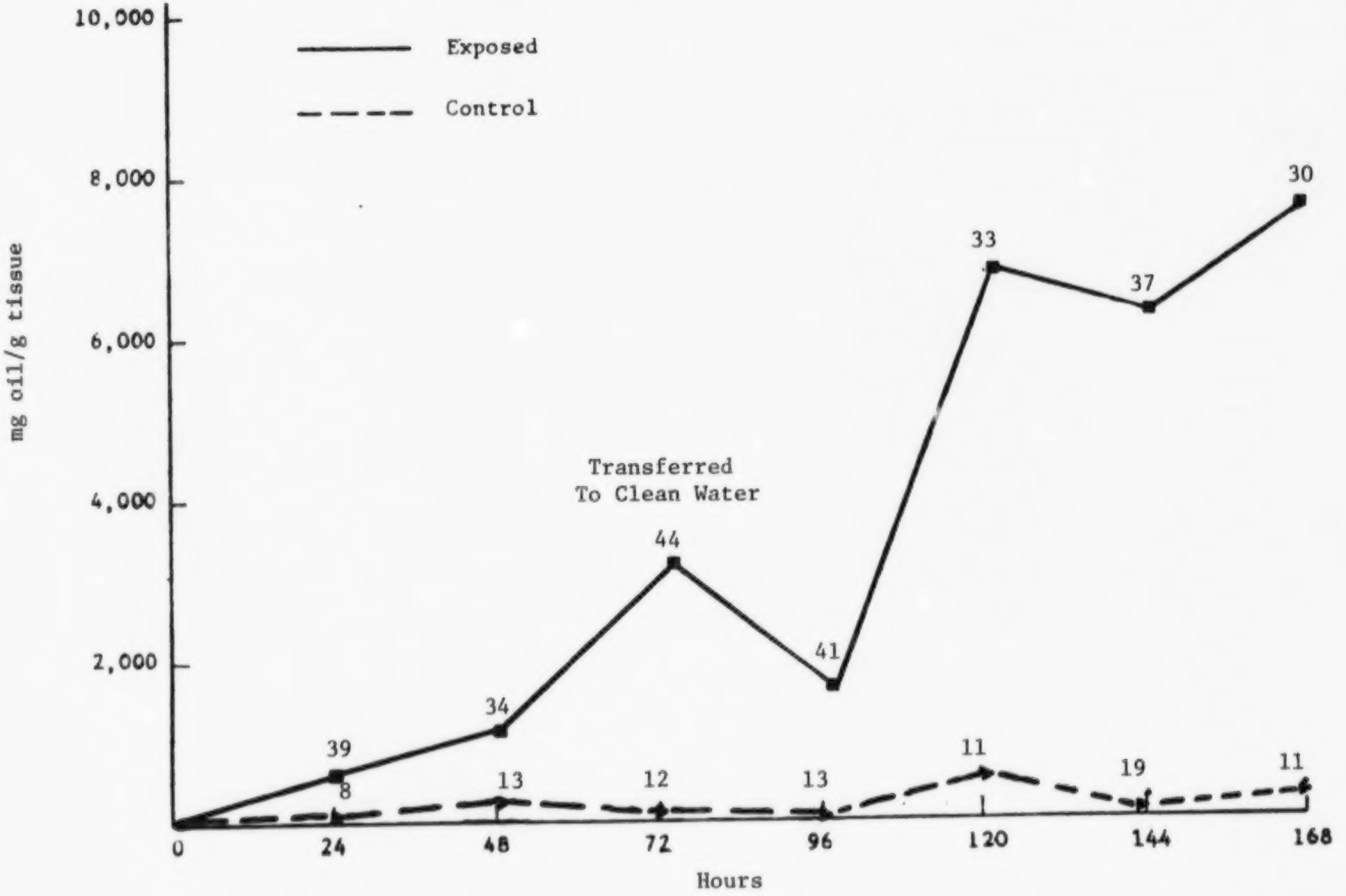
Item 136

Data derived from liquid chromatographic analysis of whole body samples of oysters exposed to Empire Mix and Saudi Arabian crude oil at concentrations of 10, 25, 50 and 75 ppm for 4 days. All oysters were alive when sampled. Weights are in micrograms and oil is quantitated as micrograms/gram.

Sampling	ppm	Empire Mix Exposed Oysters		Saudi Arabian Exposed Oysters	
		wt.	total oil	wt.	total oil
1	10	12.7	29.0	6.2	40.0
2	10	4.6	88.0	4.8	34.0
3	10	3.7	47.0	3.9	5.0
4	10	8.9	94.0	5.2	25.0
5	10	4.3	59.0	3.7	0
6	10	3.1	102.0	1.6	7.0
7	10	2.9	76.0	6.4	4.0
8	10	2.4	65.0	5.1	28.0
9	10	1.8	153.0	5.5	75.0
10	10	4.8	177.0	3.1	0
11	25	7.2	43.0	1.6	368.0
12	25	5.9	76.0	2.2	48.0
13	25	1.8	40.0	4.1	186.0
14	25	7.7	87.0	1.1	66.0
15	25	4.8	101.0	3.6	46.0
16	25	2.2	108.0	4.8	0
17	25	3.5	191.0	3.4	21.0
18	25	2.5	71.0	3.5	271.0
19	25	2.4	147.0	3.5	28.0
20	25	6.4	100.0	4.4	79.0
21	50	6.9	85.0	6.5	45.0
22	50	2.6	484.0	5.3	132.0
23	50	4.4	420.0	3.6	8.0
24	50	1.1	183.0	2.7	0
25	50	7.2	103.0	3.7	13.0
26	50	6.8	98.0	3.3	174.0
27	50	6.4	76.0	2.8	63.0
28	50	5.6	354.0	5.96	132.0
29	50	10.0	221.0	6.33	458.0
30	50	4.1	403.0	3.5	85.0
31	75	9.9	67.0	5.7	202.0
32	75	7.6	440.0	3.4	139.0
33	75	7.9	169.0	2.9	871.0
34	75	3.8	52.0	2.8	45.0
35	75	4.8	449.0	2.7	480.0
36	75	7.3	40.0	4.4	98.0
37	75	4.0	239.0	3.1	33.0
38	75	4.6	441.0	3.1	10.0
39	75	2.1	108.0	2.2	0
40	75	4.0	-	1.1	133.0

Item 136 (cont'd)

Sampling	ppm	Empire Mix Exposed Oysters wt.	Empire Mix Exposed Oysters total oil	Saudi Arabian Exposed Oysters wt.	Saudi Arabian Exposed Oysters total oil
41	0	5.3	<7	2.34	<11
42	0	4.3	<7	3.8	<11
43	0	2.7	<7	2.8	<11
44	0	2.4	<7	1.7	<11
45	0	5.6	<7	5.2	<11
46	0	3.4	<7	3.4	<11
47	0	2.76	<7	1.9	<11
48	0	2.45	<7	3.8	<11
49	0	5.65	<7	1.6	<11
50	0	2.8	<7	1.5	<11



Calculated amount of Empire Mix Crude Oil in Whole Oysters as Determined by Liquid Chromatographic Analysis after Exposure to 75 ppm Oil over a Period of 72 hours Followed by Depuration for 96 hours (Number by each point represents number of Specimens Analyzed - Average Values Plotted).

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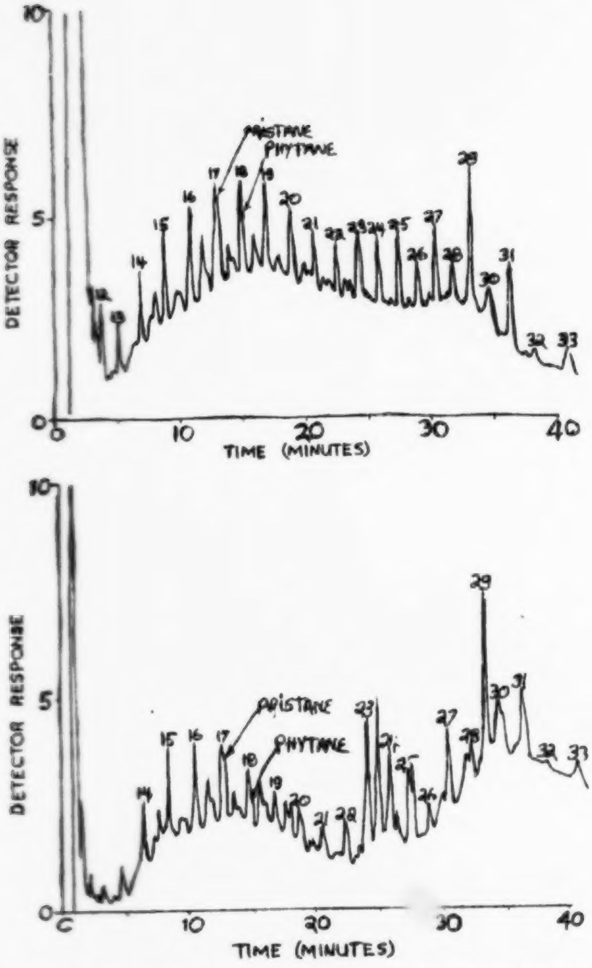

. Chromatograms showing aliphatic hydrocarbons from oil-spill pond. Core taken August 8, 1973. *Top:* top three cm. *Bottom:* core section 9-25 cm.

Column: 6 ft X 1/8 in, 4% SE-30, Chromosorb W, AW-DMCS. Column temp program 100-250 at 4°C/min.

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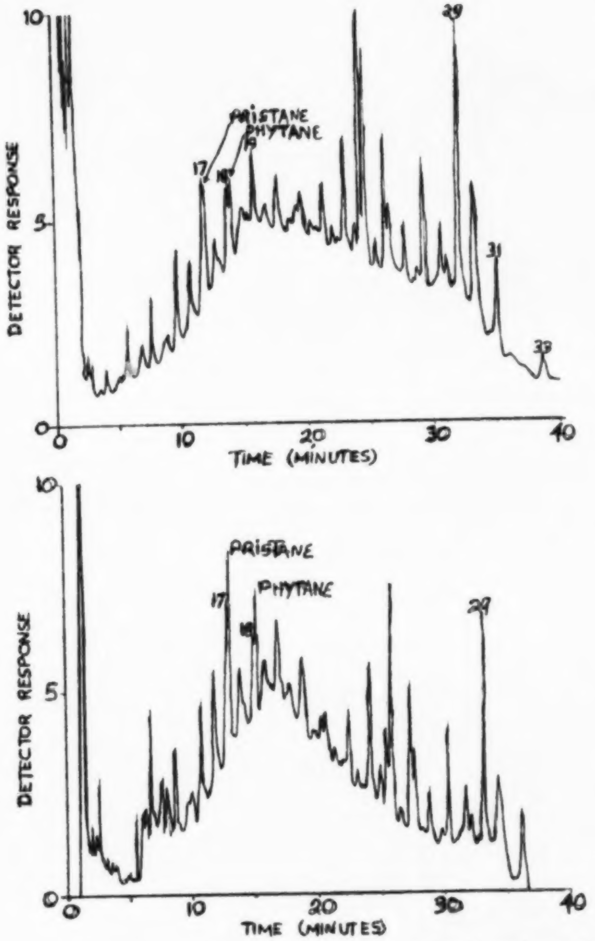
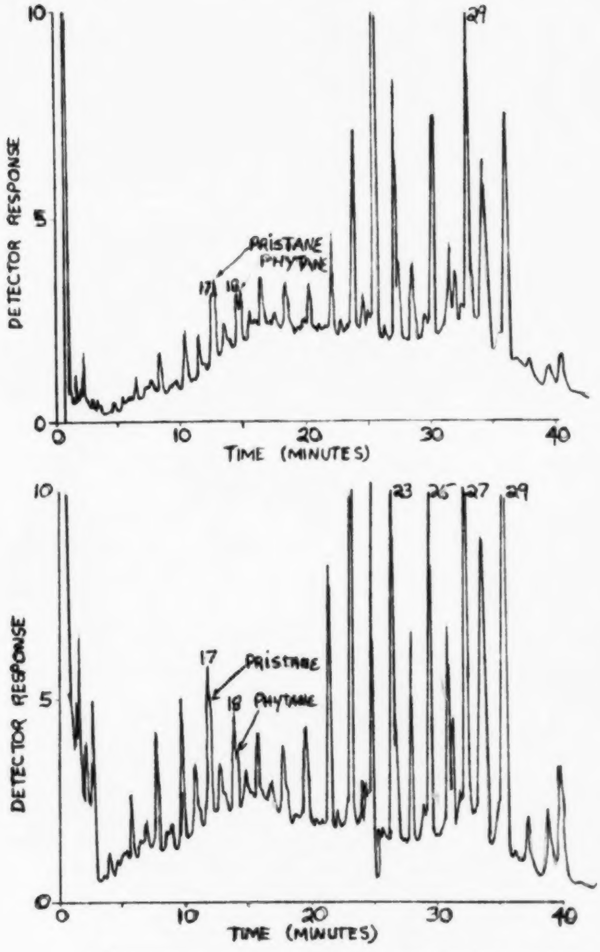


Chromatograms showing aliphatic hydrocarbons from oil-spill pond. Core taken November 30, 1973. *Top:* top 3 cm. *Bottom:* core section 3-6 cm.

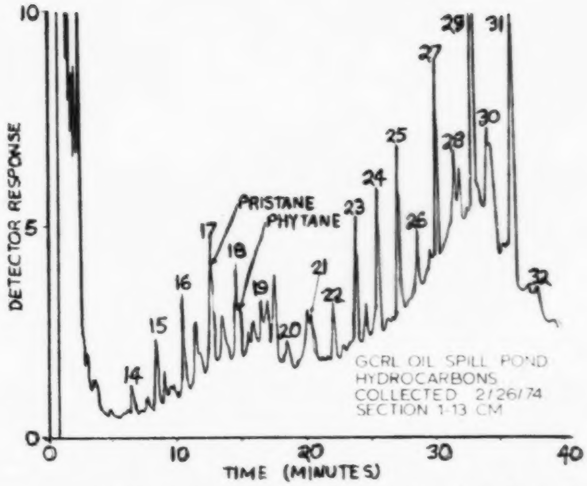
Column: 6 ft X 1/8 in, 4% SE-30, Chromosorb W, AW-DMCS. Column temp program 100-250 at 4°C/min.



Chromatograms showing aliphatic hydrocarbons from oil-spill pond. Core taken November 30, 1973. *Top:* core section 6-25 cm. *Bottom:* core section 25-34 cm.

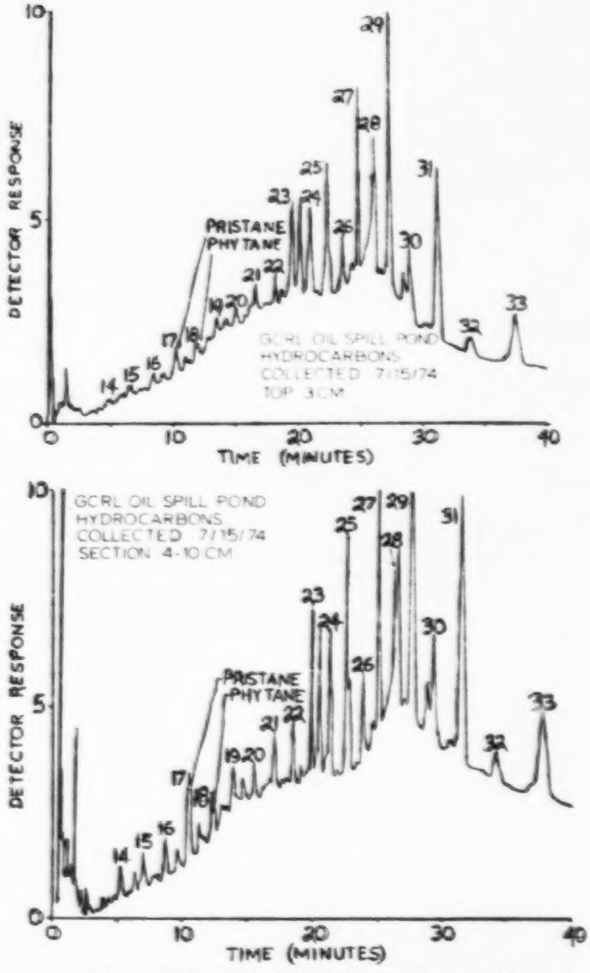
Column: 6 ft × 1/8 in, 4% SE-30, Chromosorb W, AW-DMCS. Column temp program 100-250 at 4°C/min.

Item 141



Chromatogram showing aliphatic hydrocarbons from oil-spill pond. Core taken February 26, 1974. Core section 1-13 cm.

Column: 6 ft X 1/8 in, 4% SE-30, Chromosorb W, AW-DMCS. Column temp program 100-250 at 4°C/min.



Chromatograms showing aliphatic hydrocarbons from oil-spill pond. Core taken July 15, 1974. *Top:* core section top 3 cm. *Bottom:* core section 4-10 cm.

Column: 6 ft X 1/8 in, 4% SE-30, Chromosorb W, AW-DMCS. Column temp program 100-250 at 4°C/min.

Comparison of results of in situ light and dark B.O.D. Experiments in the control (clear) and experimental (oil) ponds 16 days after simulation of an oil spill; spill concentration of experiment water was 1.45 ppm.

Experimental Conditions	Parameter Measured	mgC/m^3/hr Control	 Oil
1			
3 replicates 3 hours (0900-1200) 7-10 0.00S 30-32°C	GPP NPP R	166.22 114.28 62.33	93.50 51.94 44.87
2			
3 replicates 5 hours (0900-1400) 7-10 0/00S 30-32°C	GPP NPP R	249.33 218.17 67.62	137.13 74.80 34.40
3			
3 replicates 1.5 hours (1400-1550) 7-10 0/00S	GPP NPP R	353.22 270.11 99.73	187.00 145.44 49.87

Note: Differences in mgC/m/hr among the three experiments due to increasing intensity of ambient solar radiation during the day.

GPP = Gross Primary Productivity

NPP = Net Primary Productivity

R = Respiration

Item 144

Comparison of results of in situ light and dark B.O.D. experiments in control (clear) and experimental (oil) ponds 60 days after simulation of an oil spill; oil concentration of experimental pond was a trace amount (Undetectable below 1 ppm).

Experimental Conditions	Parameter Measured	mgC/m^3/hr	
		Control	Oil
6 replicates	GPP	248.29	206.74
6 hours (0900-1500)			
8 0/00s	NPP	191.15	156.35
34°C	R	64.82	60.46

GPP = Gross Primary Productivity

NPP = Net Primary Productivity

R = Respiration

Comparison of results of in situ light and dark B.O.D. bottle experiments in the control and experimental ponds prior to simulated oil spill.

Experimental Conditions	Parameter Measured	mgC/m^3/hr	
		Control	Oil
6 replicates	GPP	156.0	144.7
5 hours (0900-1400)	NPP	95.3	92.7
9-12 0-00S	R	74.4	74.5
21°C			

GPP = Gross Primary Productivity

NPP = Net Primary Productivity

R = Respiration

Item 145

Uptake of crude oil by marsh plant materials after 16 days of exposure to simulated oil spill in the tidal marsh pond.

Sample	Total Oil By GC (ug/g)	Total Oil By LC (ug/g)
Roots		
Top 15 cm of core		
Oil	110.34	247.20
Control	N.D.	82.54
Bottom portion of core		
Oil	51.59	169.67
Control	N.D.	61.07
Detritus Material		
Oil	29.20	5052.20
Control	N.D.	140.40
Spartina cynosuroides		
Oil	22.78	26.06
Control	N.D.	27.21
Distichlis spicata		
Oil	11.79	48.78
Control	N.D.	46.73
Juncus roemerianus		
Oil	12.05	15.17
Control	6.14	9.74
Spartina alterniflora		
Oil	24.04	115.29
Control	10.35	0.0

N.D. = Not Detectable

Item 146

Uptake of crude oil by marsh plant materials after 60 days of exposure to simulated oil spill in a tidal marsh pond.

Sample	Total Oil (ug/g)	
	GC	LC
Roots		
Top 15 cm of core		
Control	9.54	14.40
Oil	10.45	87.01
Bottom part of core		
Control	4.97	12.60
Oil	6.22	15.41
Young Plants		
Regrowth from clipped plots		
Control	2.09	3.43
Oil	13.28	79.66
Juncus roemerianus		
Control	1.41	3.28
Oil	0.95	26.05
Spartina cynosuroides		
Control	1.23	0.00
Oil	1.35	0.00
Distichlis spicata		
Control	0.53	15.51
Oil	1.05	25.86
Spartina alterniflora		
Control	0.44	10.52
Oil	0.45	57.73

Item 147

. Faunal population of control and experimental ponds, pre- and post-spill, July 1973–July 1974

Species	Common Name	Pre-spill			Post-spill									
		7-18-73		7-24-73	8-15-73		10-18-73		12-14-73		2-26-74		7-15-74	
		Conurol	Exp.	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.	Control	Exp.
Brevoortia sp.	Menhaden	152	728	990	111	28	81	415	303	462	71	180	155	47
Leiostomus xanthurus	Spot	1	4	0	0	0	5	0	4	5	0	0	0	0
Fundulus grandis	Gulf killifish	9	4	6	4	16	0	0	31	36	4	15	0	0
Gambusia affinis	Mosquito fish	9	3	6	12	204	4	17	78	201	53	36	7	7
Anchoa mitchilli	Bay anchovy	40	10	16	2	22	0	124	83	78	71	8	1	1
Lagodon rhomboides	Pinfish	10	18	4	5	5	9	4	0	3	0	0	13	13
Menidia beryllina	Silverside	10	1	2	74	13	3	0	41	18	0	17	14	2
Cynoscion nebulosus	Spotted sea trout	0	0	0	0	0	1	0	0	0	0	1	0	0
Mugil cephalus	Mullet	7	1	1	9	11	3	1	1	0	10	38	0	85
Elops saurus	Ladyfish	0	3	0	0	0	0	0	0	0	0	0	2	3
Poecilia latipinna	Sailfin molly	0	0	0	0	10	1	0	0	0	44	27	0	0
Gobies		0	0	0	0	0	3	0	8	0	0	4	11	1
Callinectes sp.	Blue crab	1	1	2	1	1	17	1	2	13	0	10	2	0
Palaemonetes sp.	Grass shrimp	0	0	74	165	84	3	2	1198	1124	952	4418	8	62
Penaeus aztecus	Brown shrimp	0	0	1	0	0	13	1	8	0	0	1	3	4
Salvelinus fontinalis	Speckled trout	0	0	0	0	0	0	0	1	2	0	0	0	0
Micropogon undulatus	Atlantic croaker	0	0	0	0	0	0	0	0	0	3	10	0	1
Dormitator maculatus	Sleeper	0	0	0	0	0	0	1	0	0	0	0	0	0
Bairdiella chrysura	Silver perch	0	0	0	0	0	0	0	0	0	0	2	0	0
Fundulus similis	Longnose killifish	0	0	0	0	0	0	0	0	0	0	1	0	0

Item 148

Uptake of crude oil by selected estuarine animals after 16 days exposure to simulated oil spill in a tidal marsh pond.

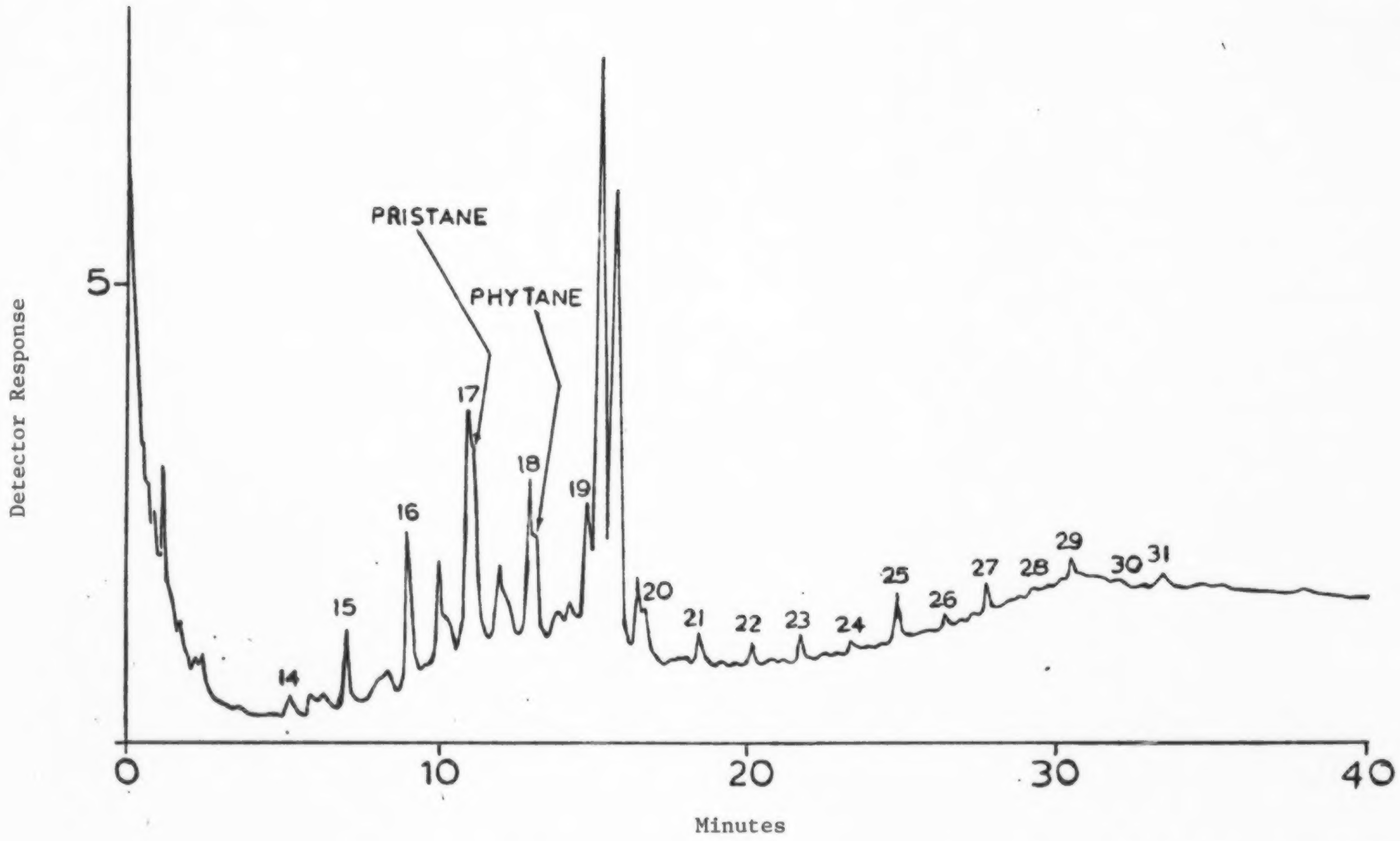
Sample	Total Oil ug/g GC	Total Oil ug/g LC
Fiddler Crabs		
Control	0.361	5.26
Oil	8.013	241.60
Marsh Snail		
Control	0.413	7.44
Oil	7.800	503.36
Blue Crab		
Control	0.468	7.50
Oil*		
Shrimp		
Control*		
Oil	0.897	67.28
Mussel		
Control*		
Oil	16.089	748.54
Fish		
Control*		
Oil	10.195	45.64

---

* No specimens were obtained.

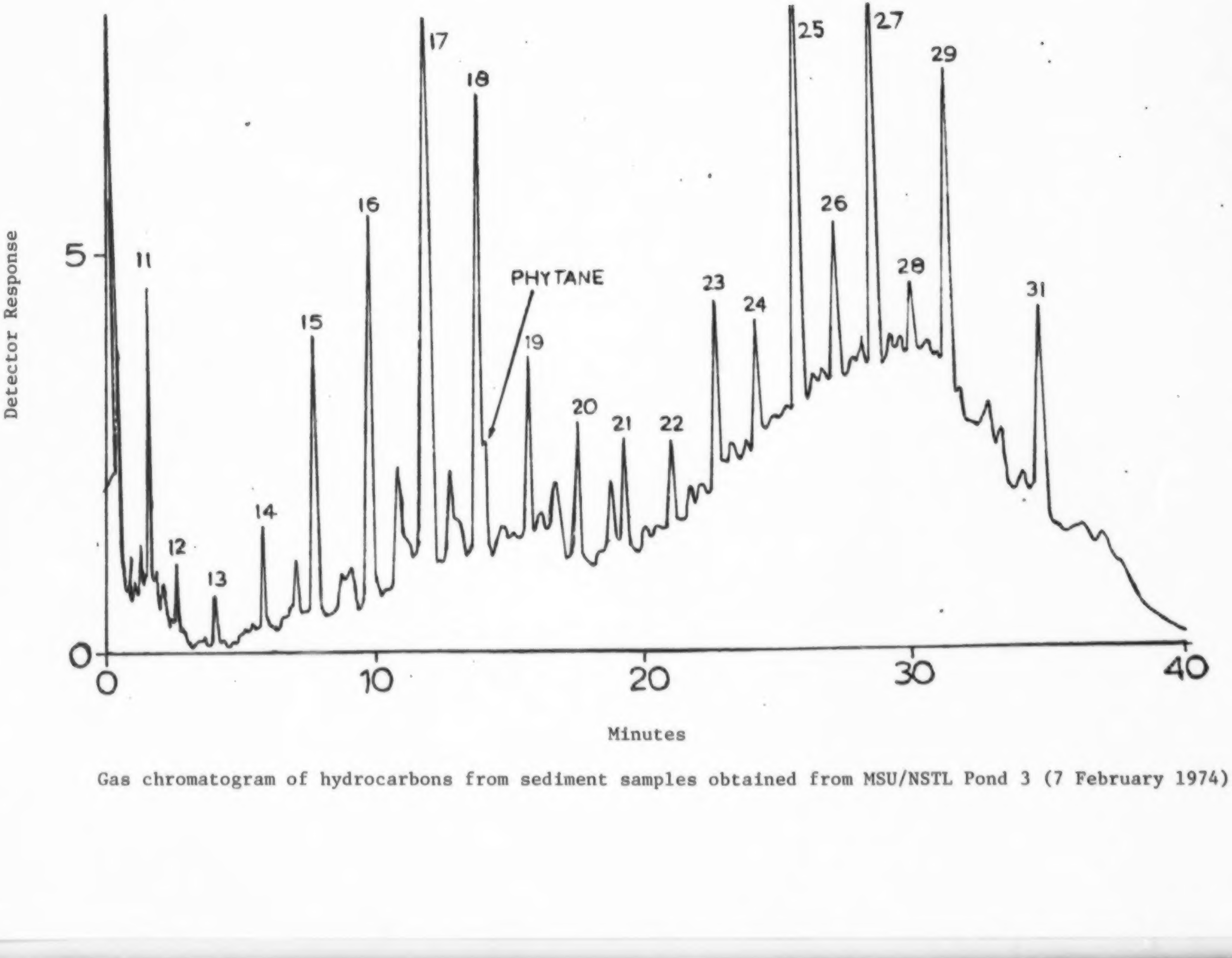
Baseline data derived from GC analysis of sediment samples taken from the MSU/NSTL Ponds on 7 February 1974.

	Pond 5	Pond 4	Pond 2	Pond 3
Dry weight	2,472.30 g	2,005.67 g	2,380.30 g	2,221.90 g
Lipid weight	2.2930 g	1.7642 g	0.3340 g	1.3360 g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.0019 %	0.0024 %	0.0081 %	0.0082 %
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	2.063 %	2.70 %	5.75 %	1.37 %
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.093 %	0.088 %	0.014 %	0.060 %

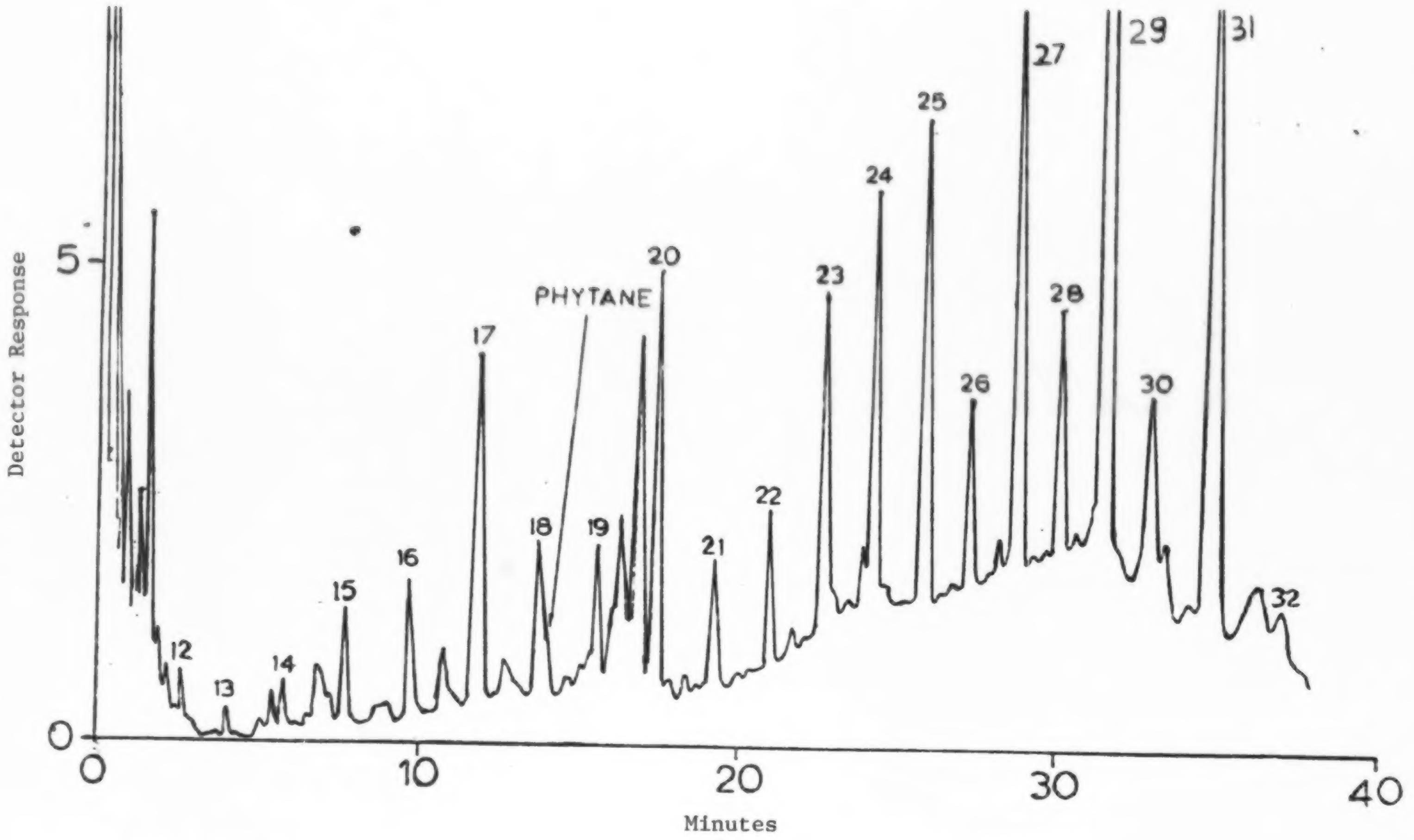


Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL Pond 2 (7 February 1974).

Item 151

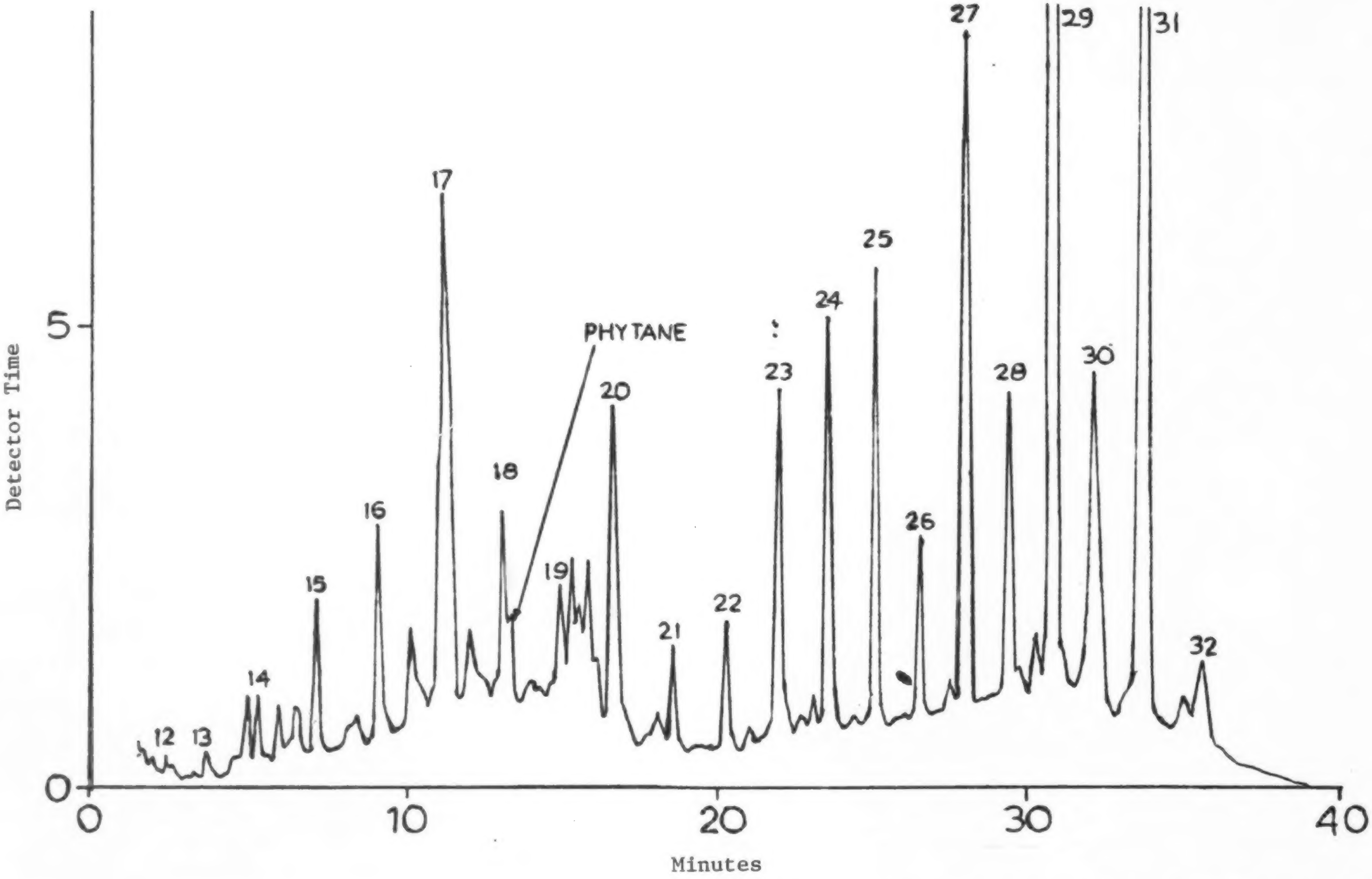


Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL Pond 3 (7 February 1974).



Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL Pond 4 (7 February 1974).

Item 153

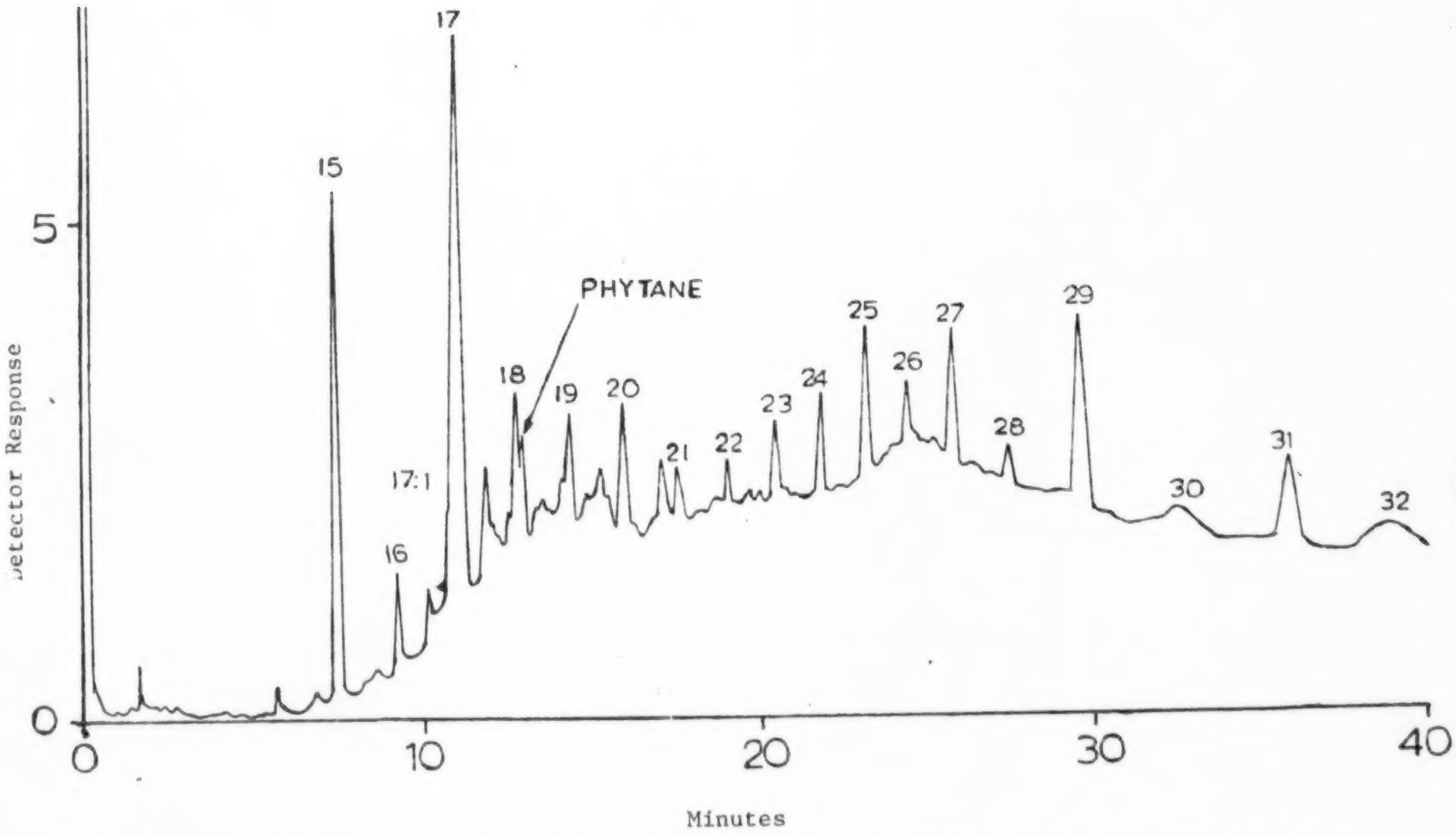


Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL Ponds 5 (7 February 1974).

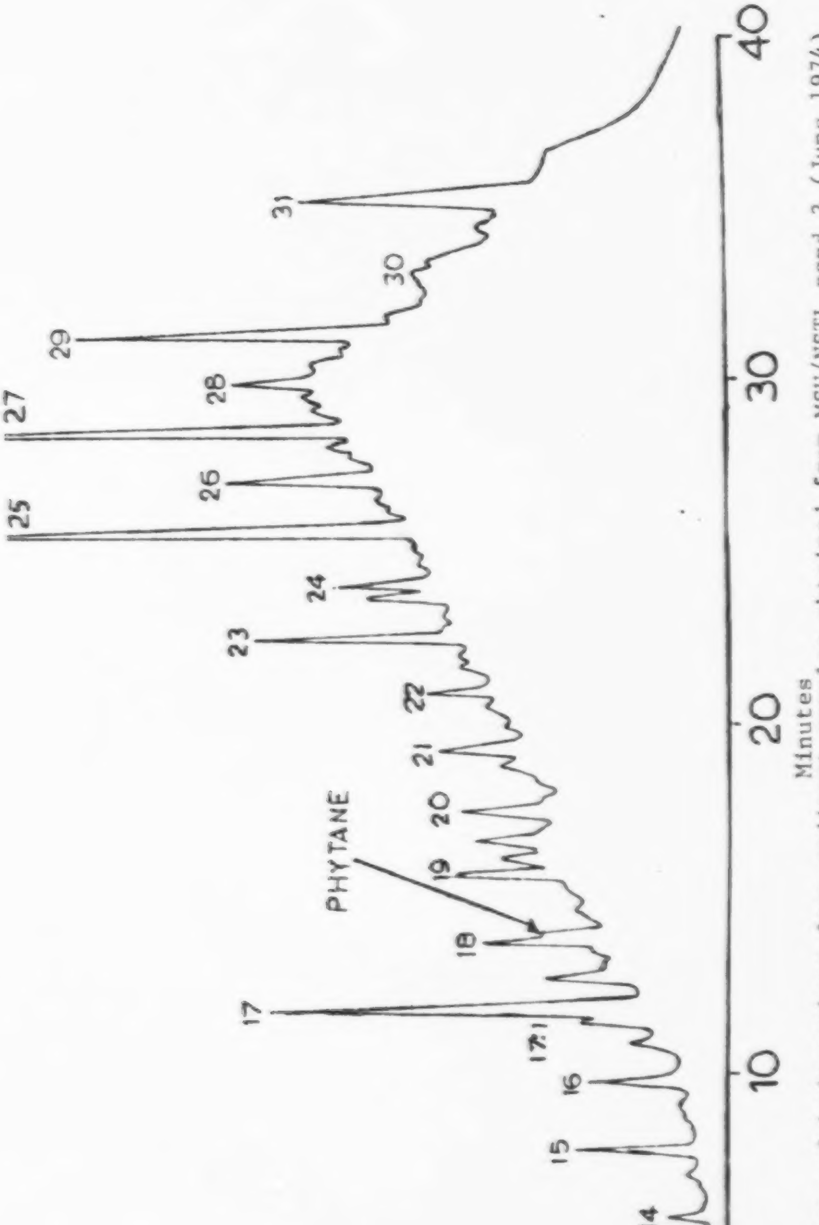
Item 154

Pre-spill data derived from GC analysis of surface sediment samples taken from MSU/NSTL Ponds on 26 June 1974.

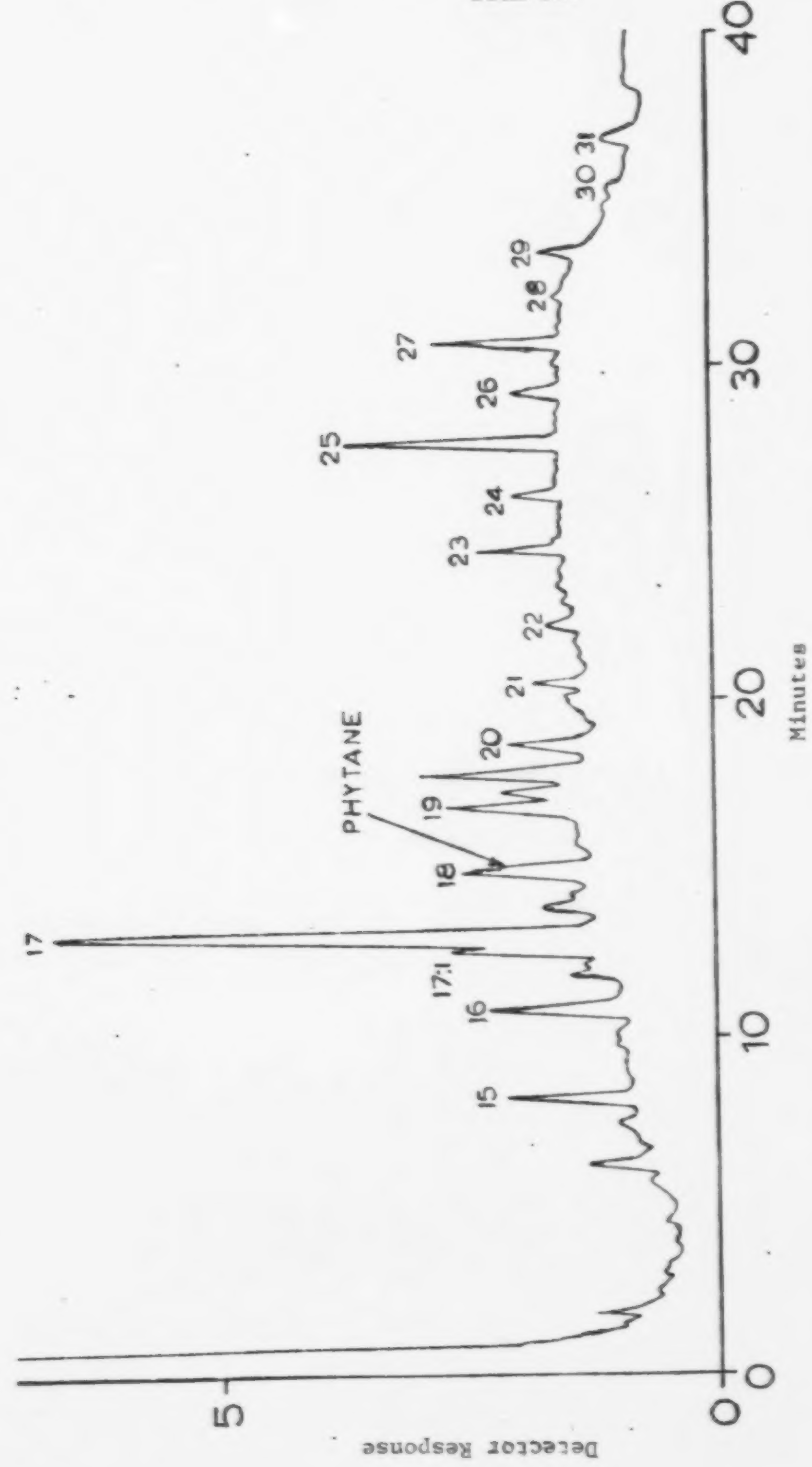
	Pond 4	Pond 3	Pond 5	Pond 2
Dry weight	1430.12g	1528.23g	1175.84g	1102.15g
Lipid weight	0.7058g	0.5380g	0.4430g	0.4758g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.0016%	0.0012%	0.0045%	0.0014%
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	3.222%	3.309%	5.698%	3.207%
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.0494%	0.0352%	0.0377%	0.0432%
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.0031%	0.0012%	0.0027%	0.0012%
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	6.349%	3.363%	7.160%	2.793%



Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL pond 2 (June 1974)

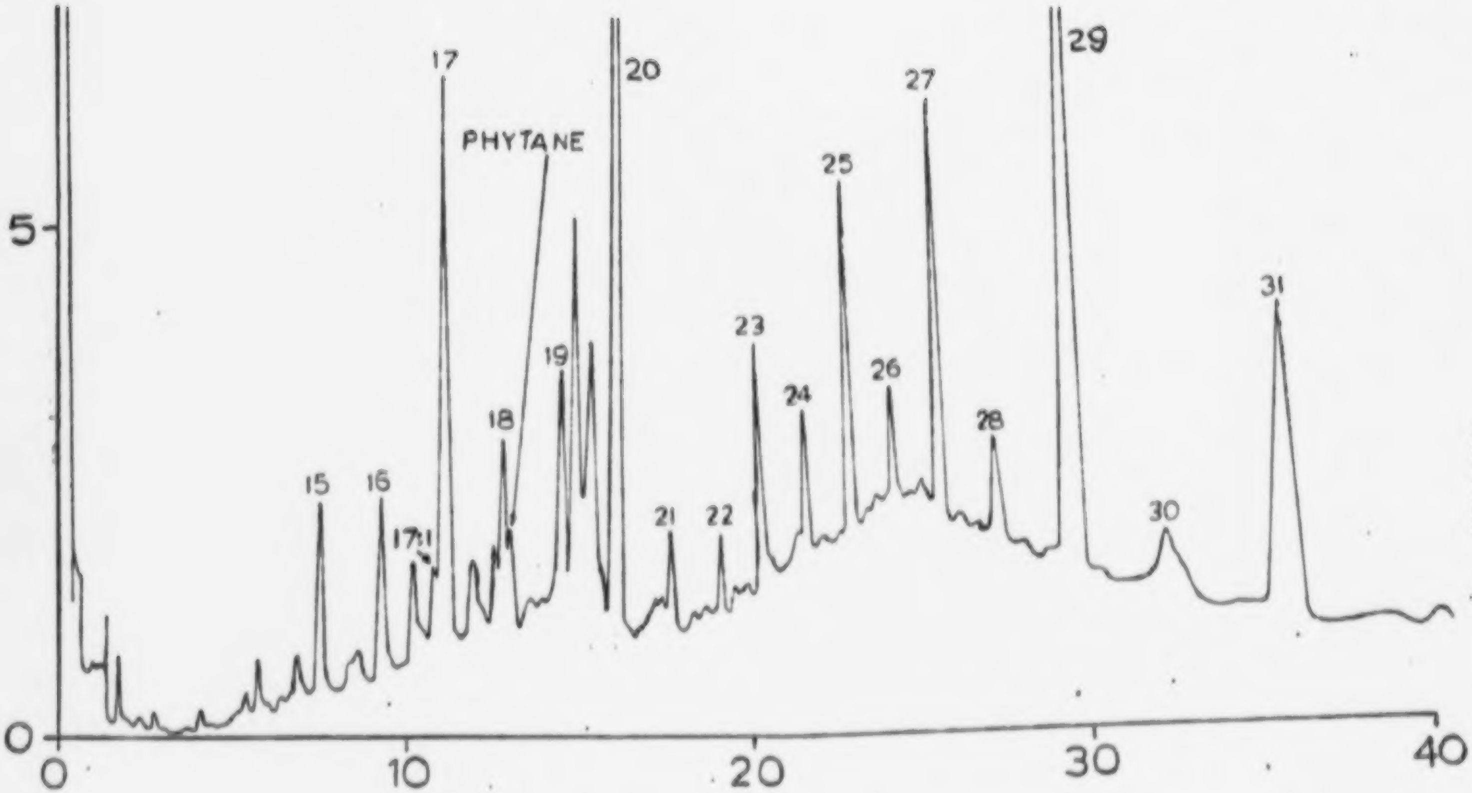


Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL pond 3 (June 1974)



Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL pond 4 (June 1974)

Item 158



Gas chromatogram of hydrocarbons from sediment samples obtained from MSU/NSTL (pond 5 (June 1974)

Item 159

Gravimetric data obtained from analysis of sediment samples collected from MSU/NSTL ponds on 9/26/74.

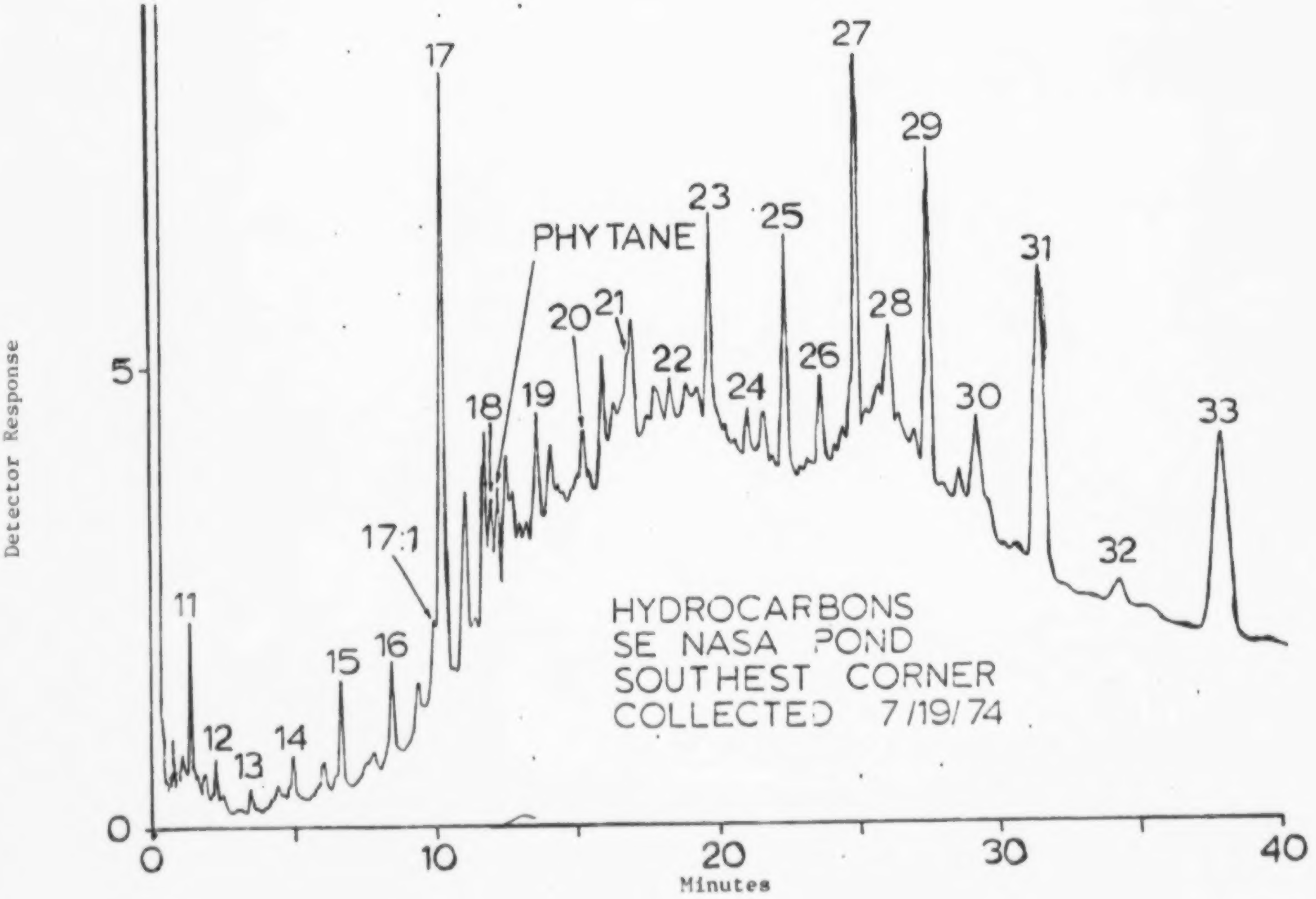
	Pond 3	Pond 4
Dry Weight	751.29g	657.57g
Lipid Weight	0.6890g	0.6706g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.0126%	0.0018%
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	13.75%	1.72%
Percent $\frac{\text{Lipid Weight}}{\text{dry weight}}$	0.09%	0.10%
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.0059%	0.0070%
Percent $\frac{\text{Aromatics}}{\text{Lipid weight}}$	6.48%	6.93%

Item 160

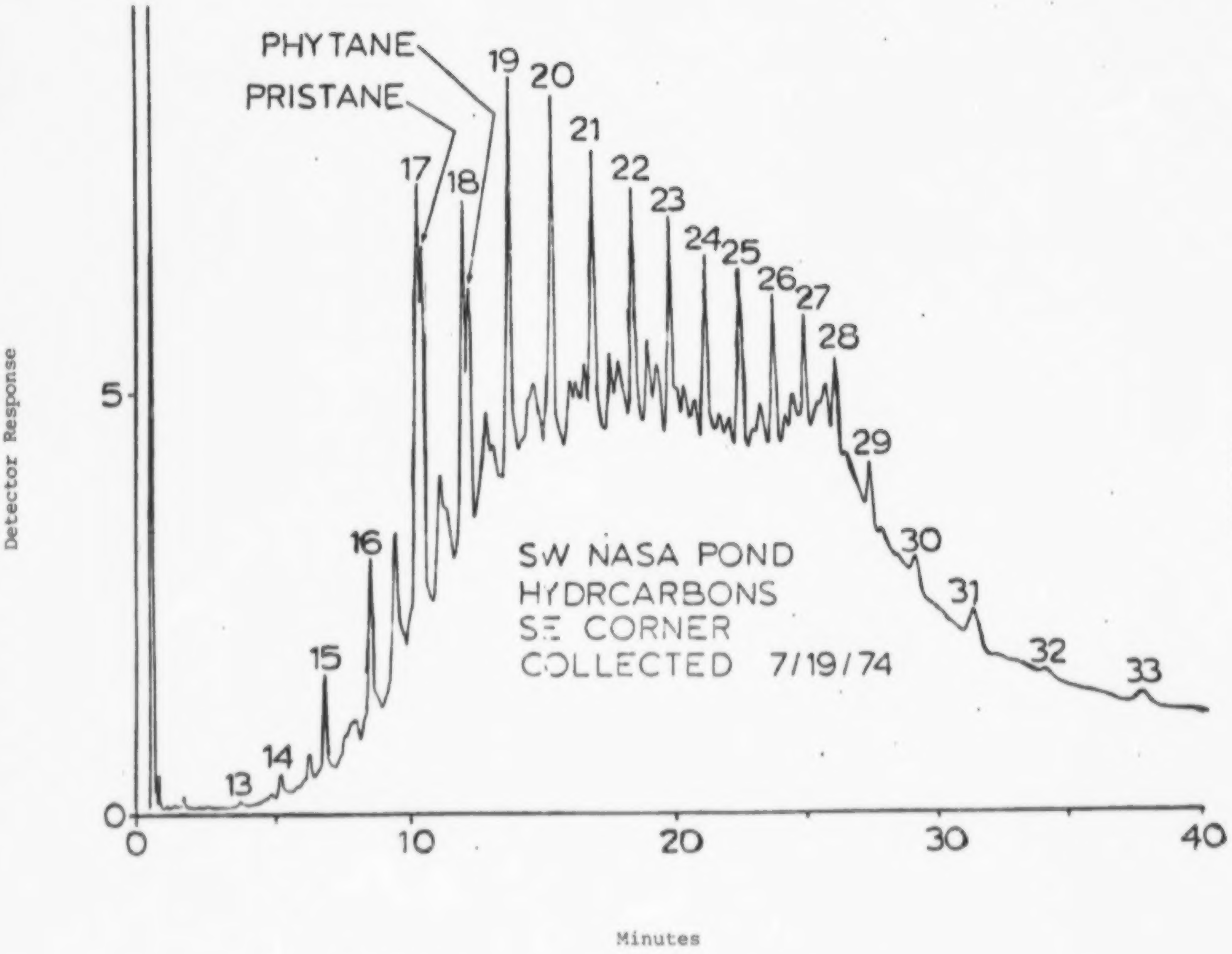
Gravimetric data obtained from analysis of sediment samples collected from MSU/NSTL ponds on 8/22/74.

	Pond 4	Pond 3	Pond 5	Pond 2
Dry weight	396.73g	318.03g	297.71g	187.93g
Lipid weight	0.3942g	0.7398g	0.5192g	0.1804g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.0036%	0.0059%	0.0024%	0.0014%
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	3.66%	2.53%	1.37%	1.44%
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.10%	0.23%	0.17%	0.10%
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.0027%	0.0064%	0.0046%	0.0008%
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	2.68%	2.74%	2.64%	0.88%

Item 161

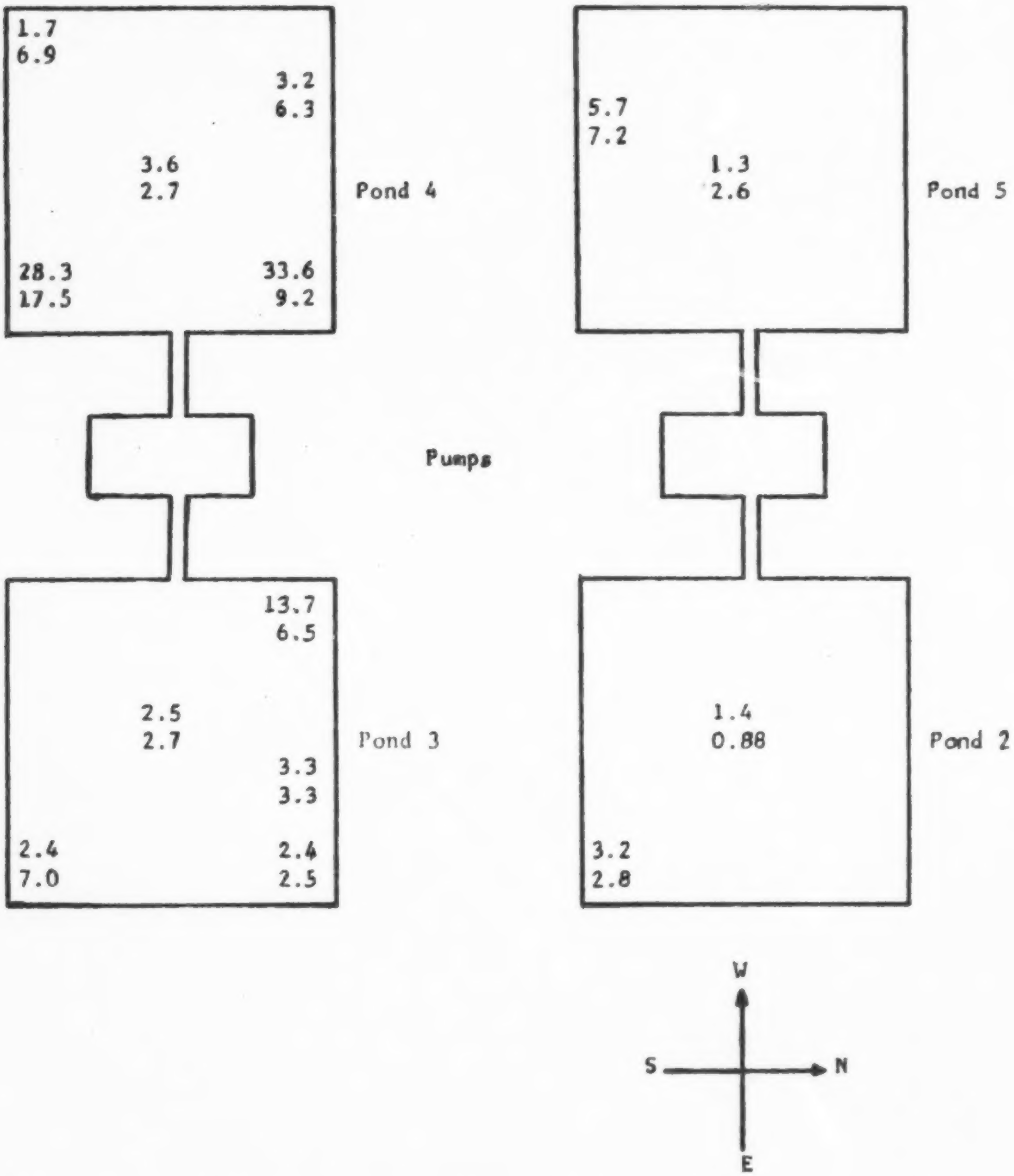


Gas chromatogram of hydrocarbons in sediments of MSU/NSTL pond 3



Gas Chromatogram of Hydrocarbons in Sediments of MSU/NSTL Pond 4

Item 163


1.7
6.9
3.2
6.3
3.6
2.7
28.3
17.5
33.6
9.2
Pond 4
5.7
7.2
1.3
2.6
Pond 5
Pumps
13.7
6.5
2.5
2.7
3.3
3.3
2.4
7.0
2.4
2.5
Pond 3
1.4
0.88
3.2
2.8
Pond 2
W
S
N
E

Distribution of aliphatic and aromatic hydrocarbons in the MSU/NSTL ecosystem research ponds. Top number represents the percentage of aliphatic hydrocarbons/lipid weight. Bottom number represents the percentage of aromatic hydrocarbons/lipid weight. Number sets are placed at the sampling site.

Item 164

Gravimetric data obtained from analysis of sediment samples collected from MSU/NSTL ponds on 1/11/75.

	Pond 2	Pond 3	Pond 4	Pond 5
Dry Weight*	838.g	598.g	741.g	762.g
Lipid weight	0.0946g	0.219g	0.300g	0.139g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.000766	0.00204	0.00146	0.00291
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	6.79	5.55	3.60	16.0
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.0113	0.0367	0.0405	0.0182
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.000410	0.00140	0.00148	0.00284
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	3.63	3.81	3.66	15.6
Percent $\frac{\text{Polar lipids}}{\text{dry weight}}$	0.00394	0.0108	0.0116	0.0105
Percent $\frac{\text{Polar lipids}}{\text{lipid weight}}$	34.9	29.4	28.7	57.5

* All sample dry weights contained some small shells.

Item 165

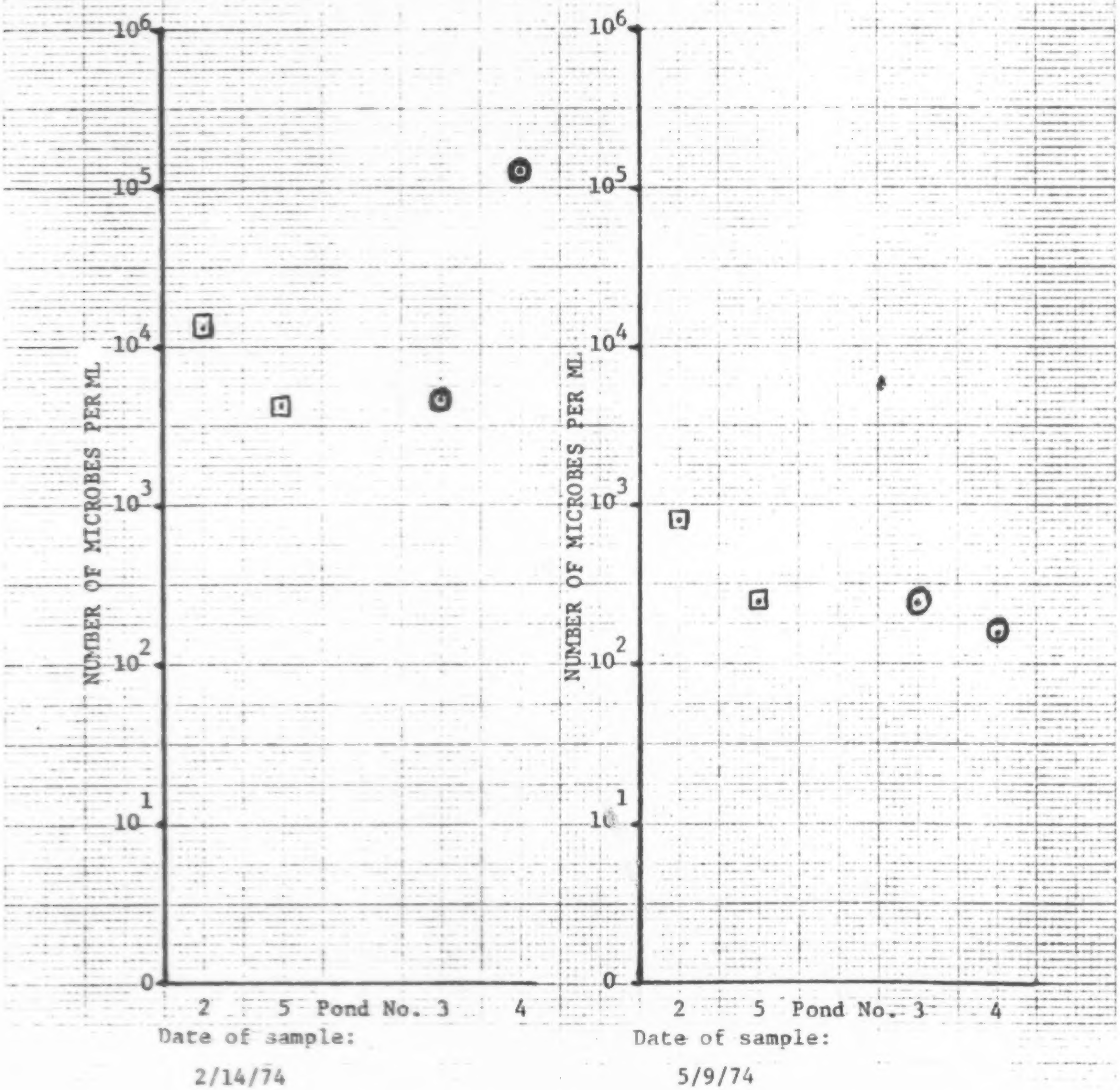
Gravimetric data obtained from the analysis of sediment samples collected from MUS/NSTL ponds on 9/22/75.

	Pond 3		Pond 4	
	Site 1	Site 2	Site 1	Site 2
Dry weight*	1,668.g	1,581.g	1,510.g	1,894.g
Lipid weight	4.55g	0.715g	1.40g	2.94g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.1080	0.00423	0.0100	0.0654
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	39.8000	9.35000	10.8000	42.2000
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.2720	0.04520	0.0929	0.1550
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.0649	0.00527	0.0123	0.0287
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	23.8000	11.60000	13.3000	18.5000
Percent $\frac{\text{Polar lipids}}{\text{dry weight}}$	0.0292	0.00782	0.0139	0.0169
Percent $\frac{\text{Polar lipids}}{\text{lipid weight}}$	10.7000	17.30000	14.9000	10.9000

*All samples contained some small shells.

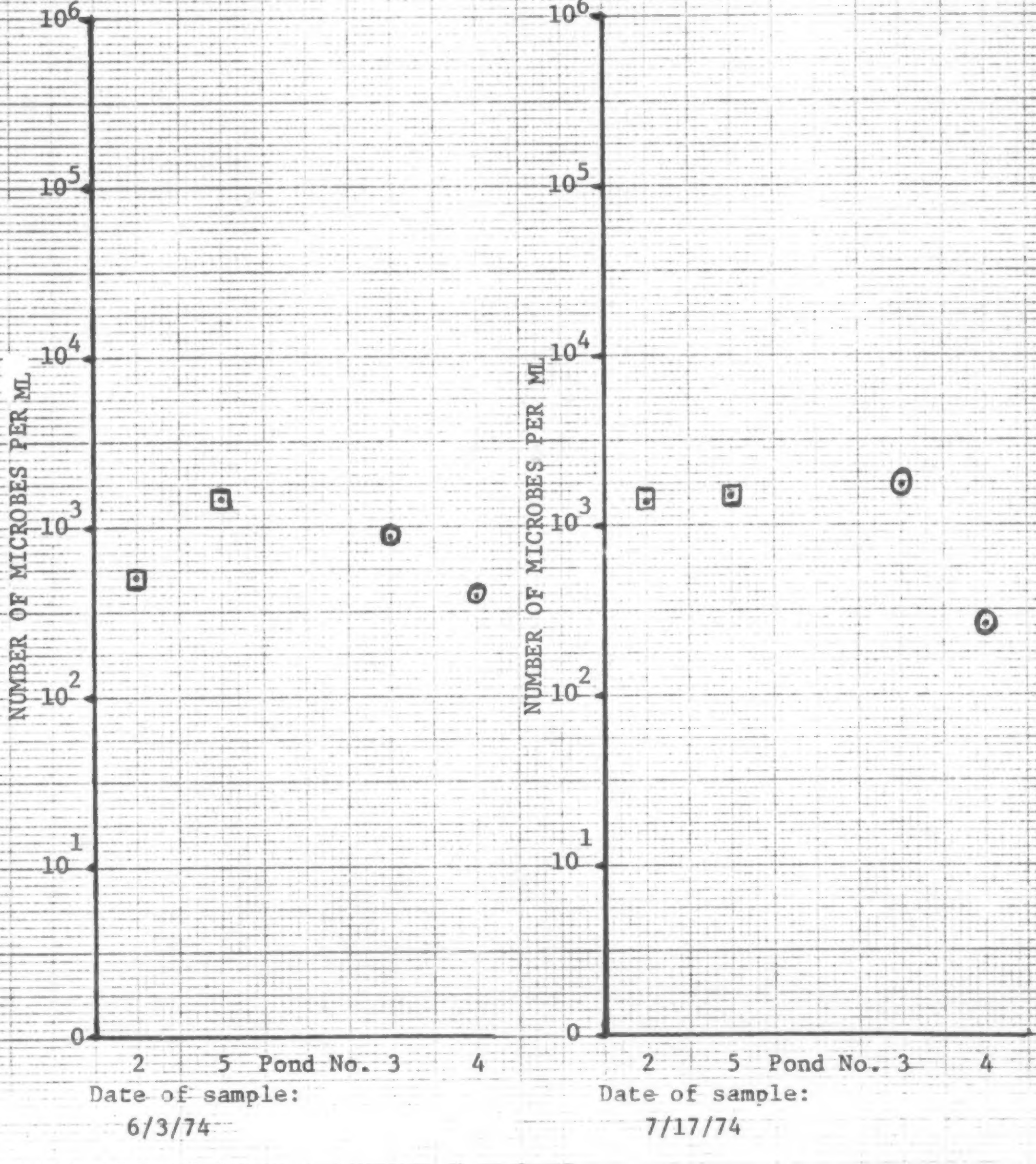
Item 166

A series of figures graphically representing the number of microbes present in in pond water samples taken on 24 sampling dates beginning 2/14/74 and ending 2/20/75.



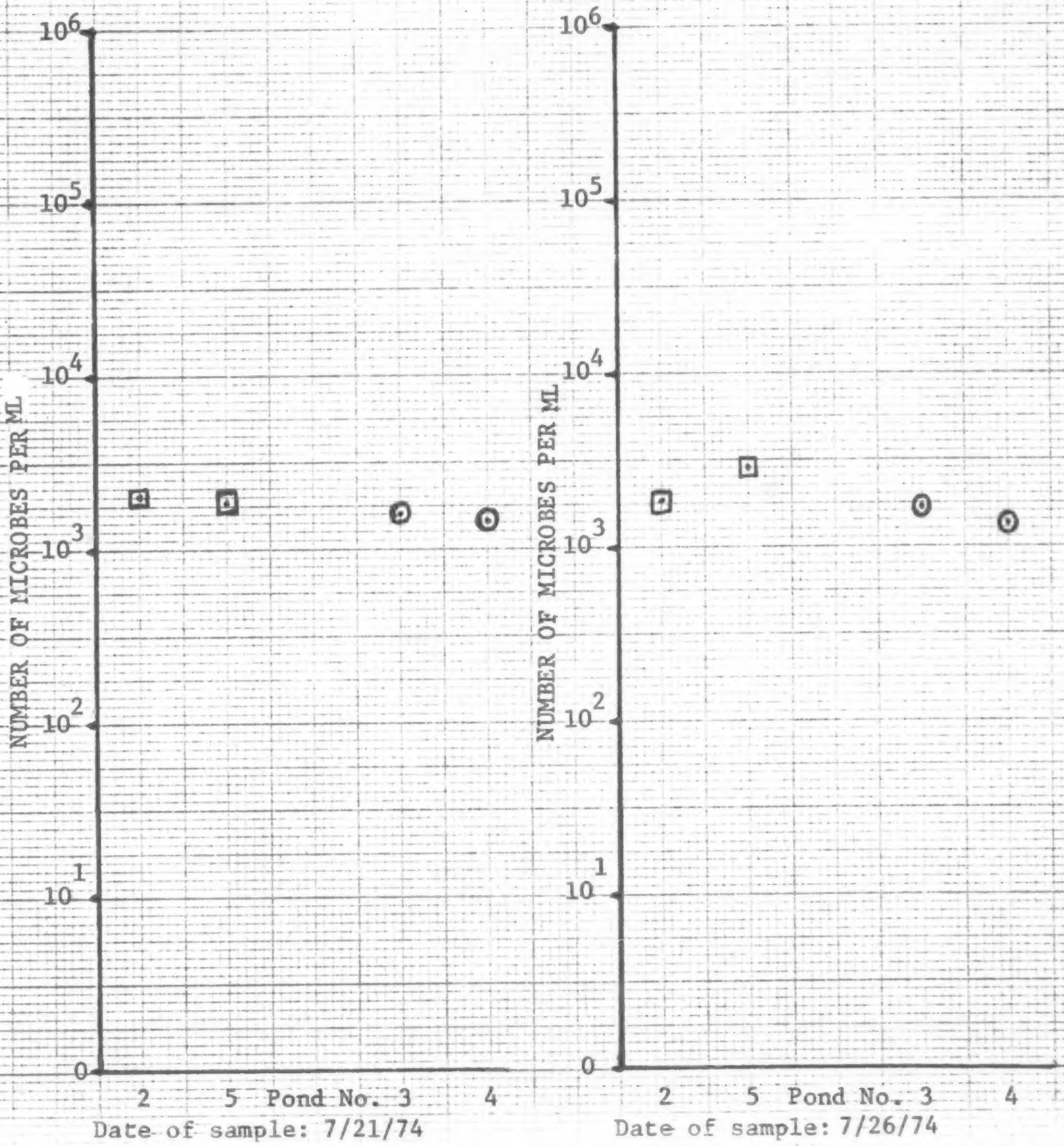
Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



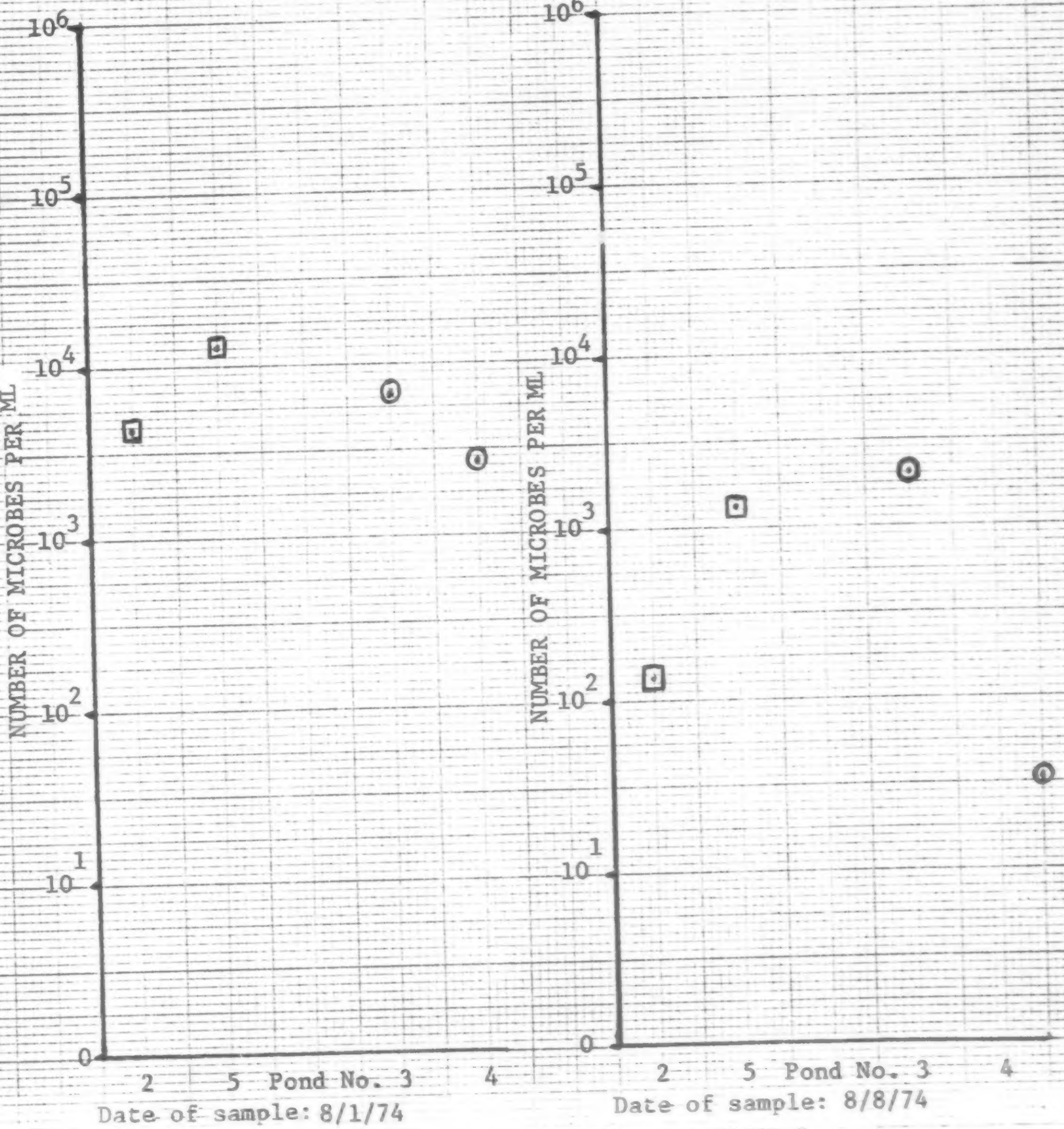
Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity. (Barge water contained 8.3×10^3 microbes/ml)

Item 166 (cont.)



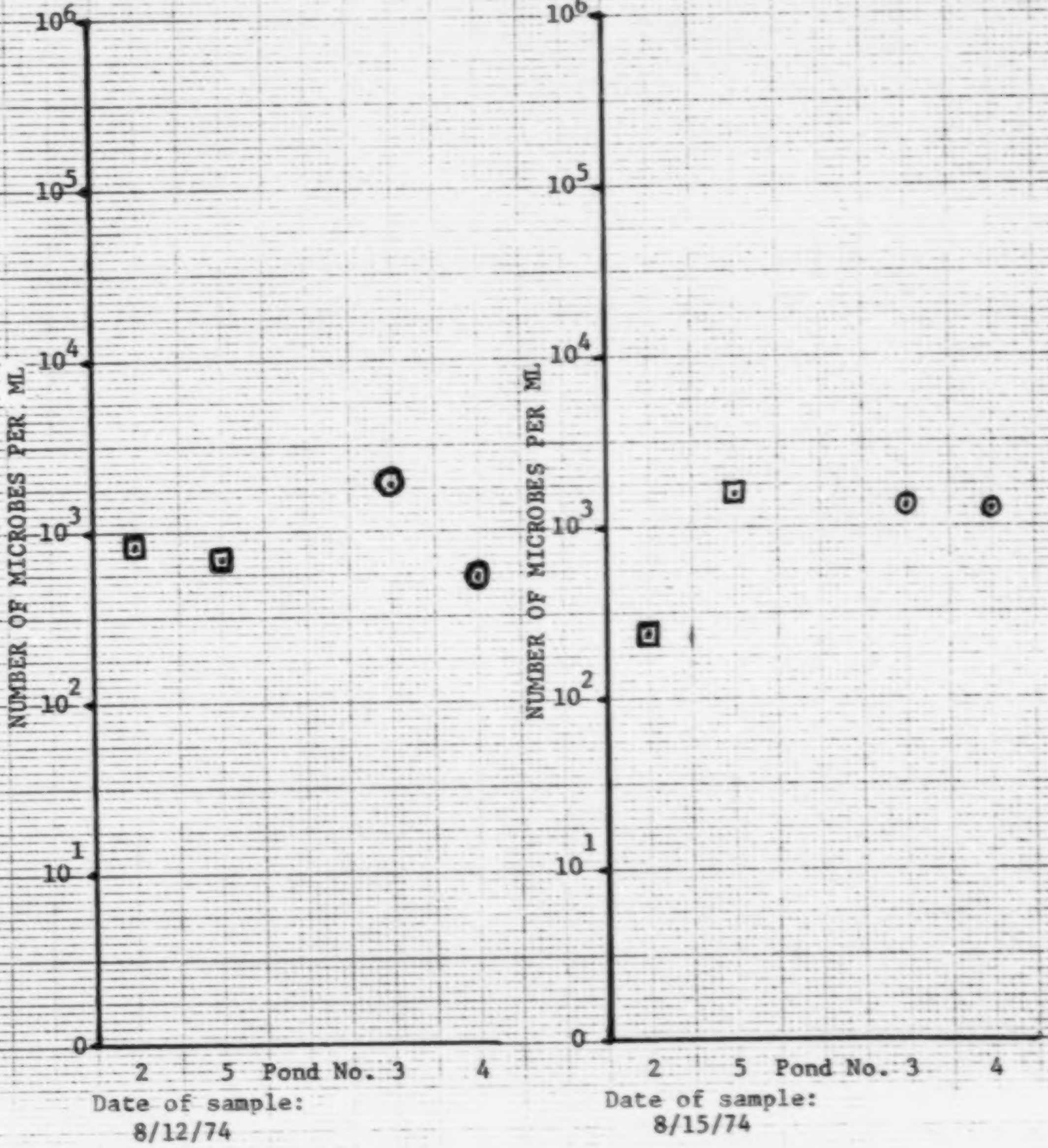
Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



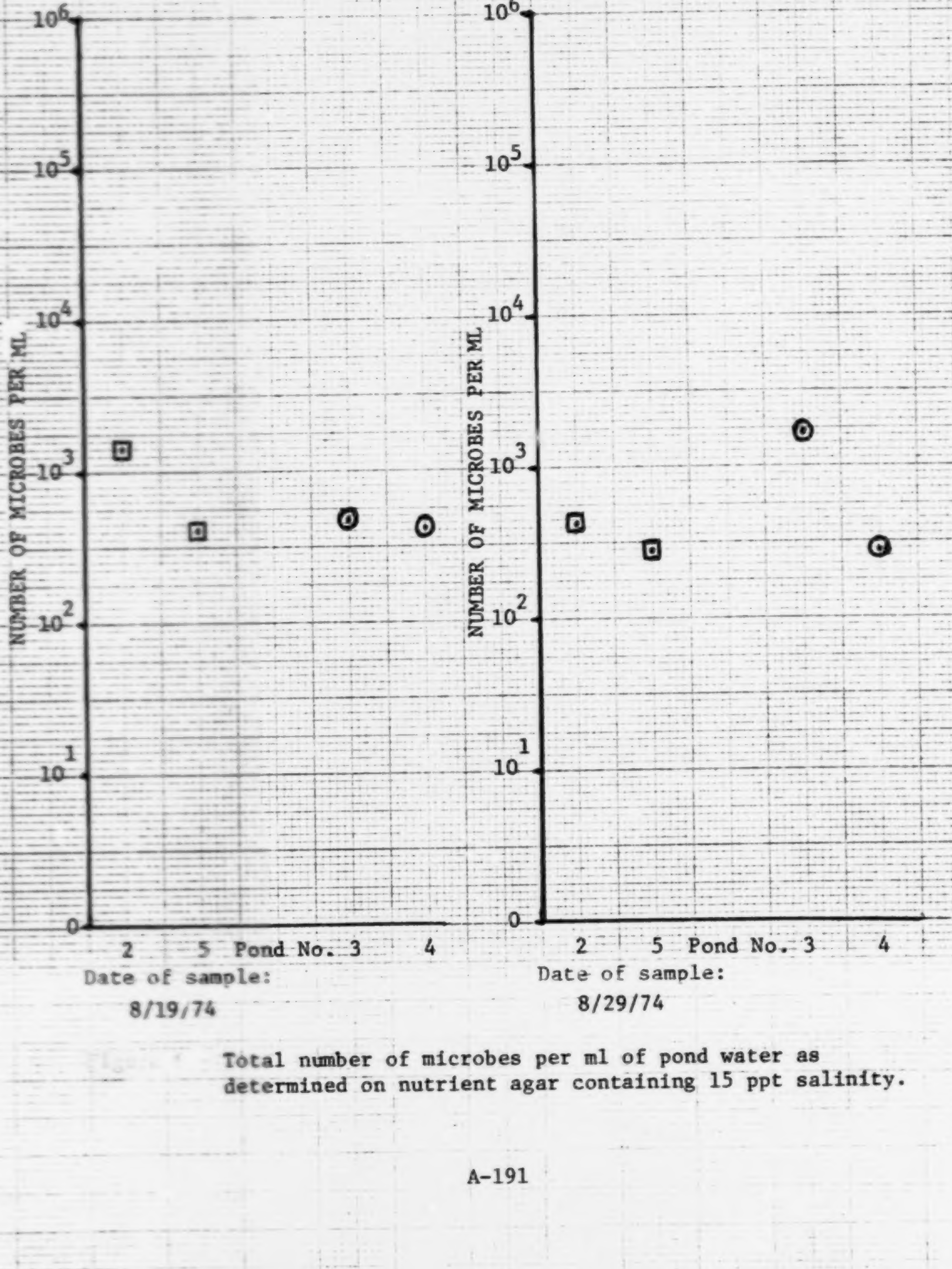
Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)

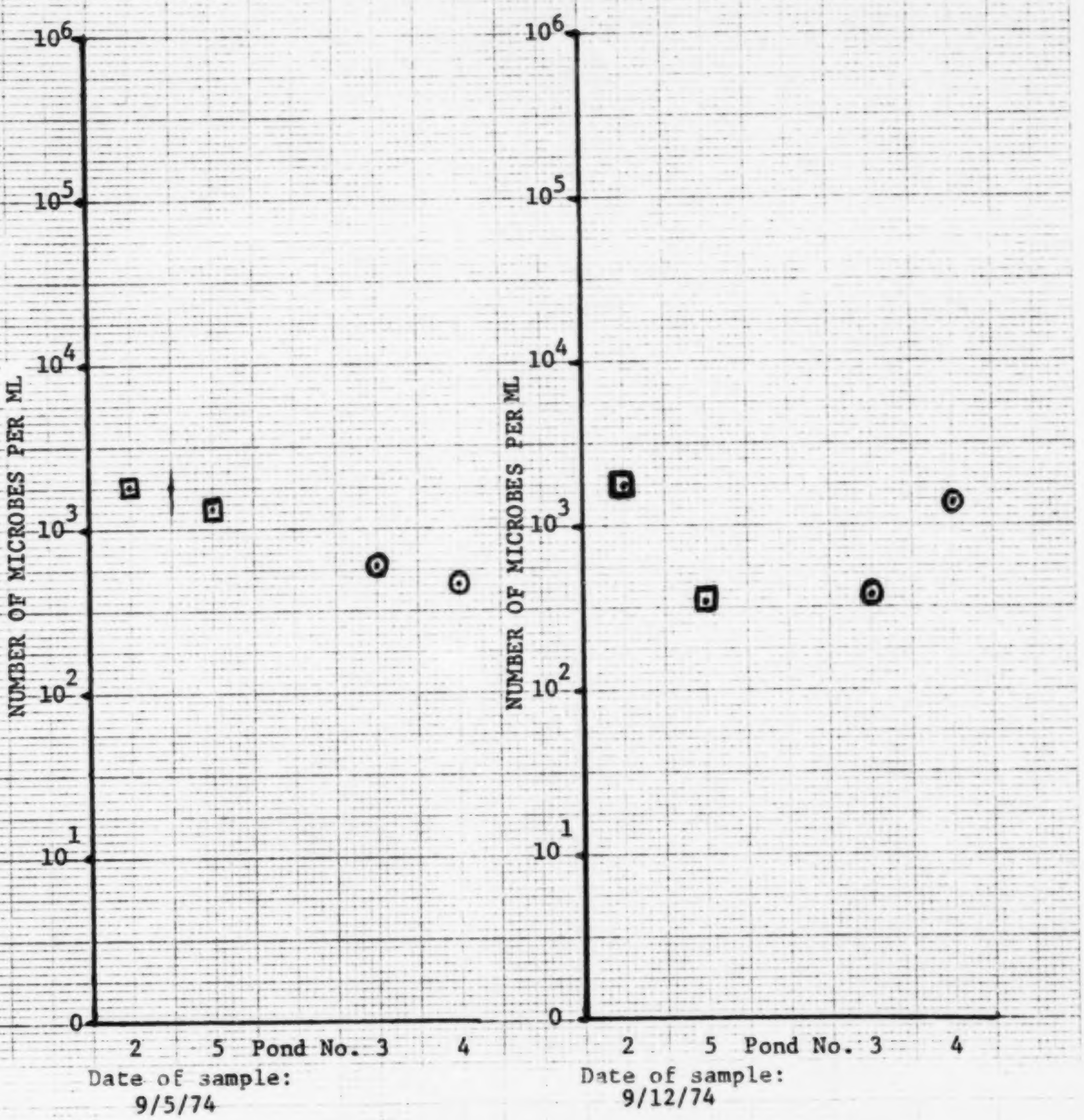
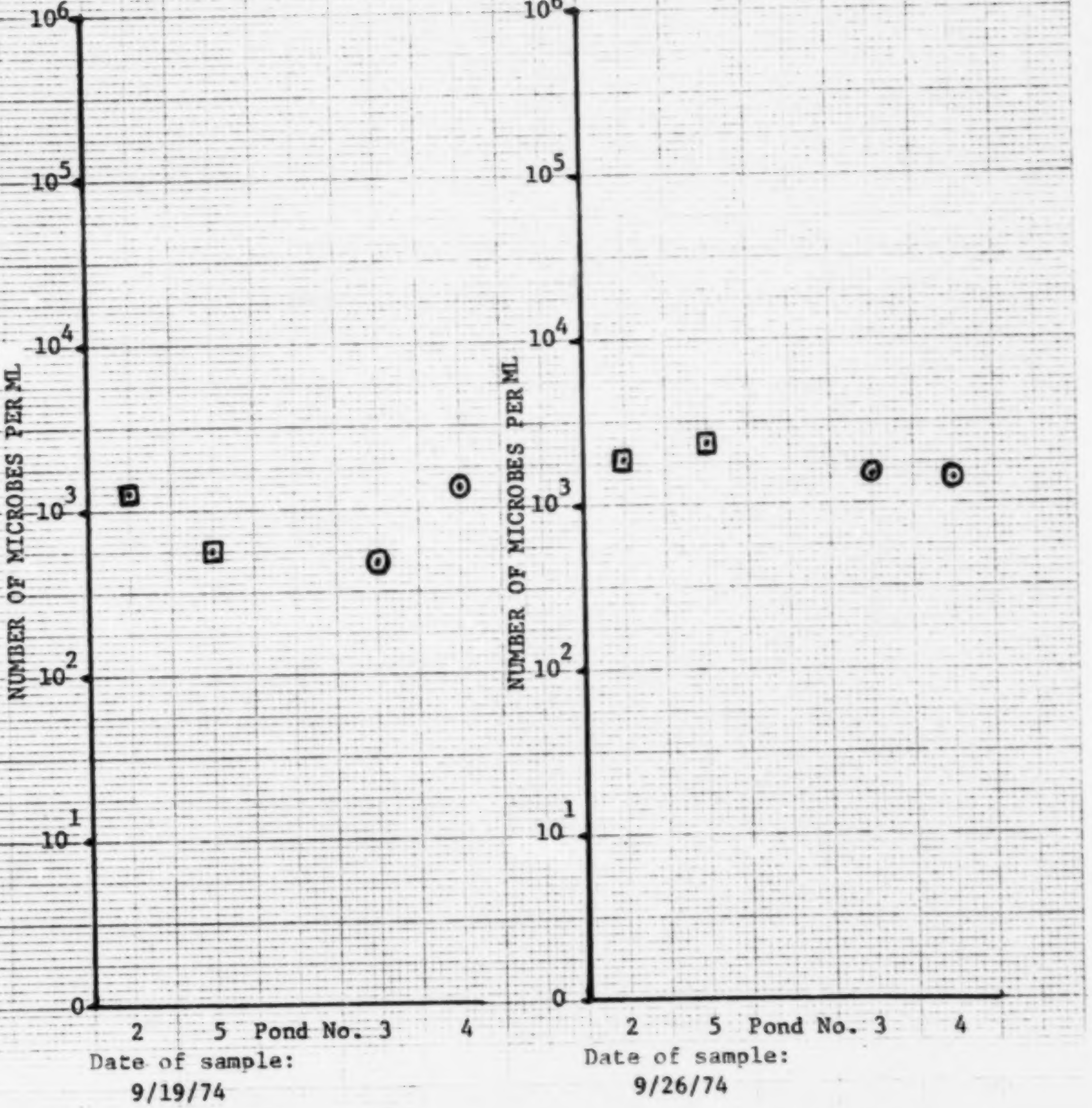


Figure - Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)

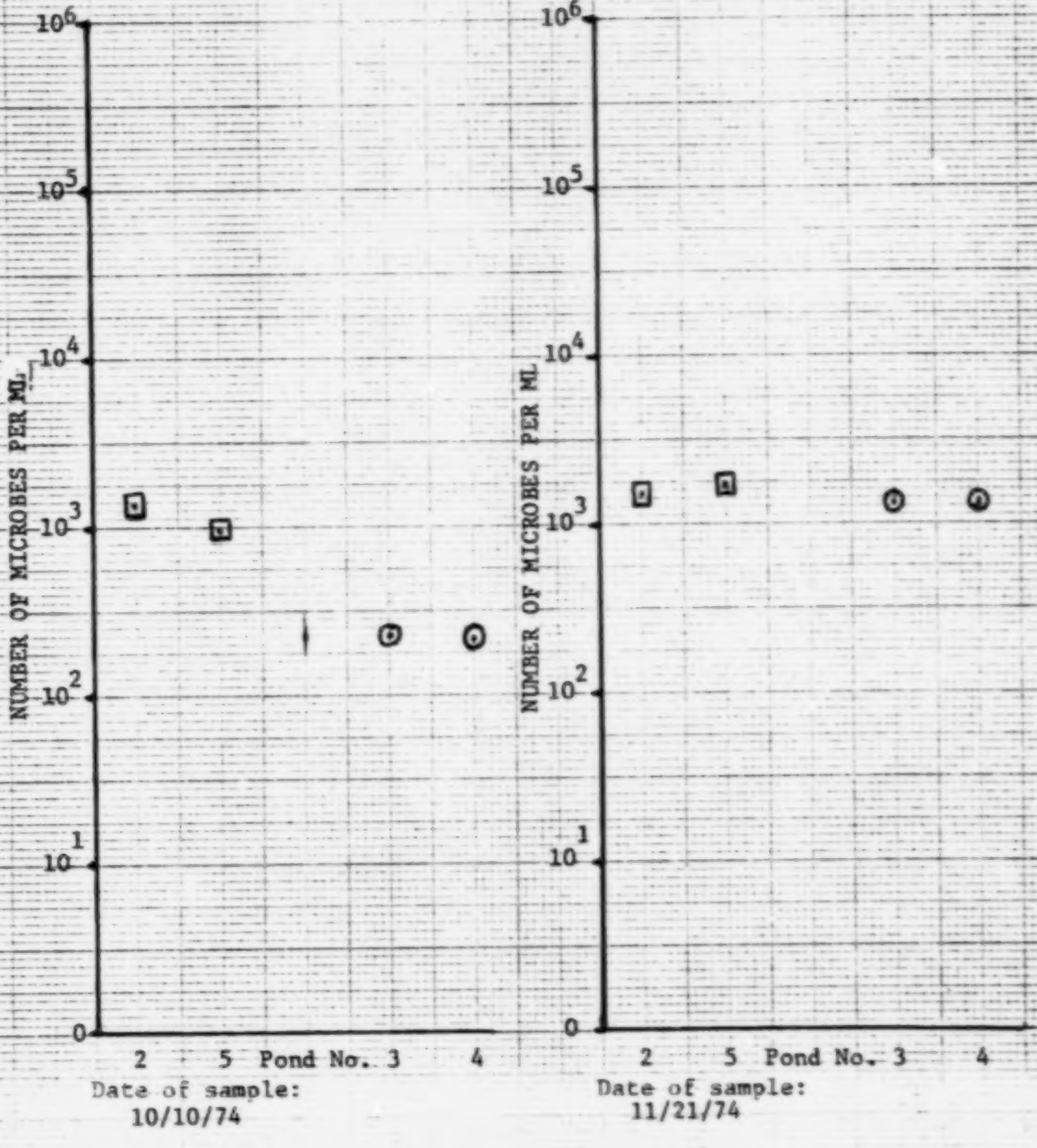
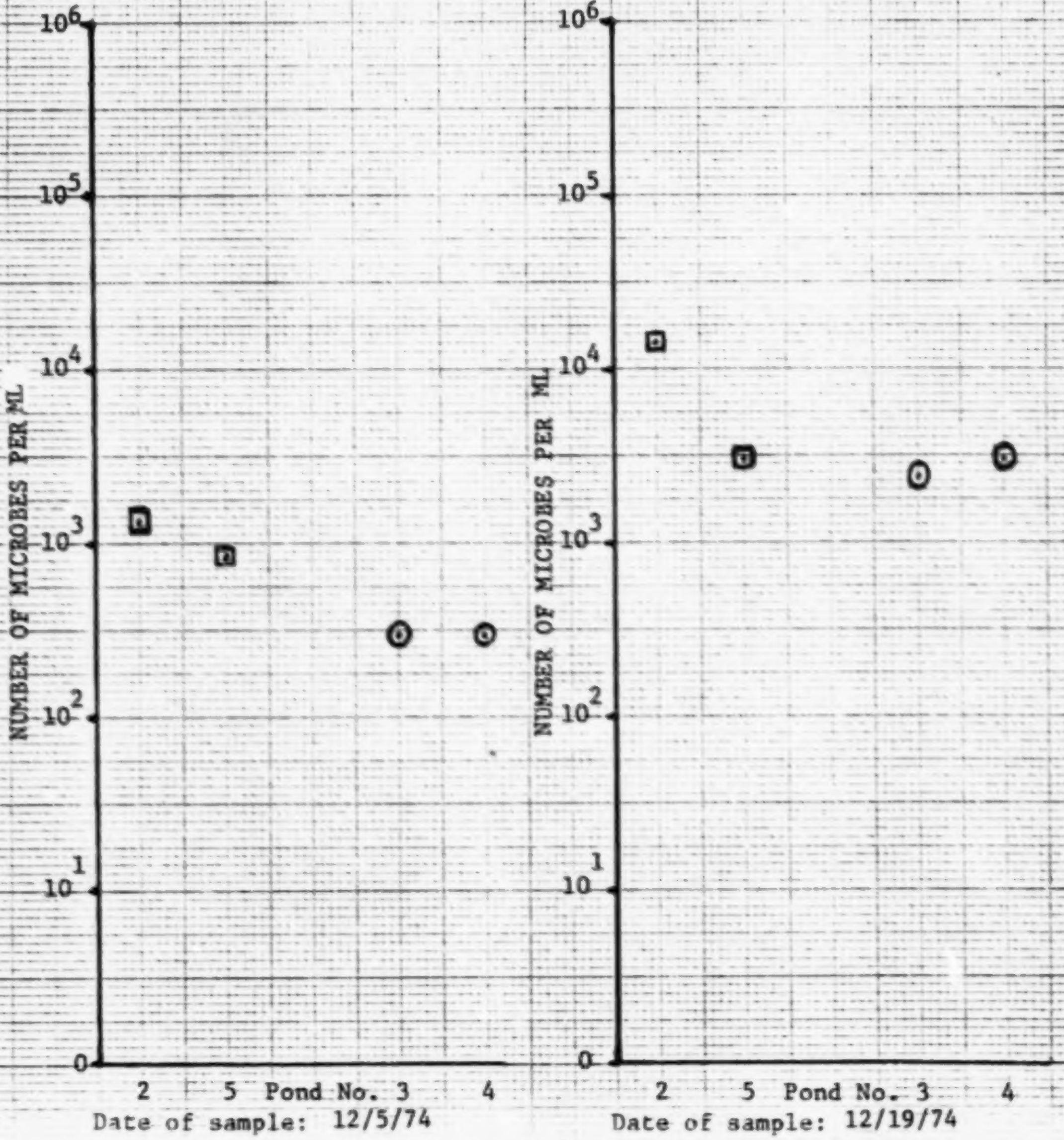


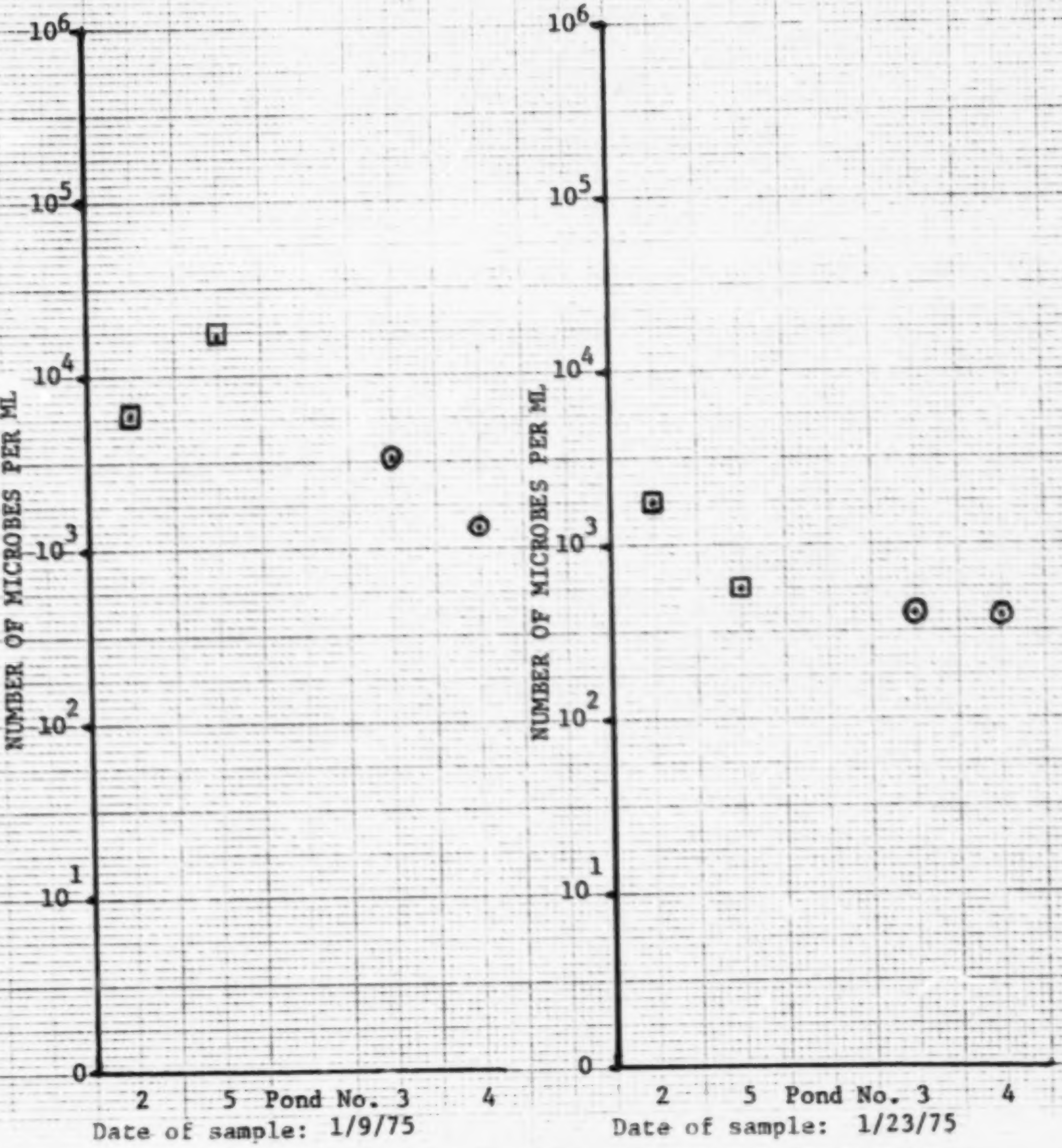
Fig. [illegible] - Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)



Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 166 (cont.)

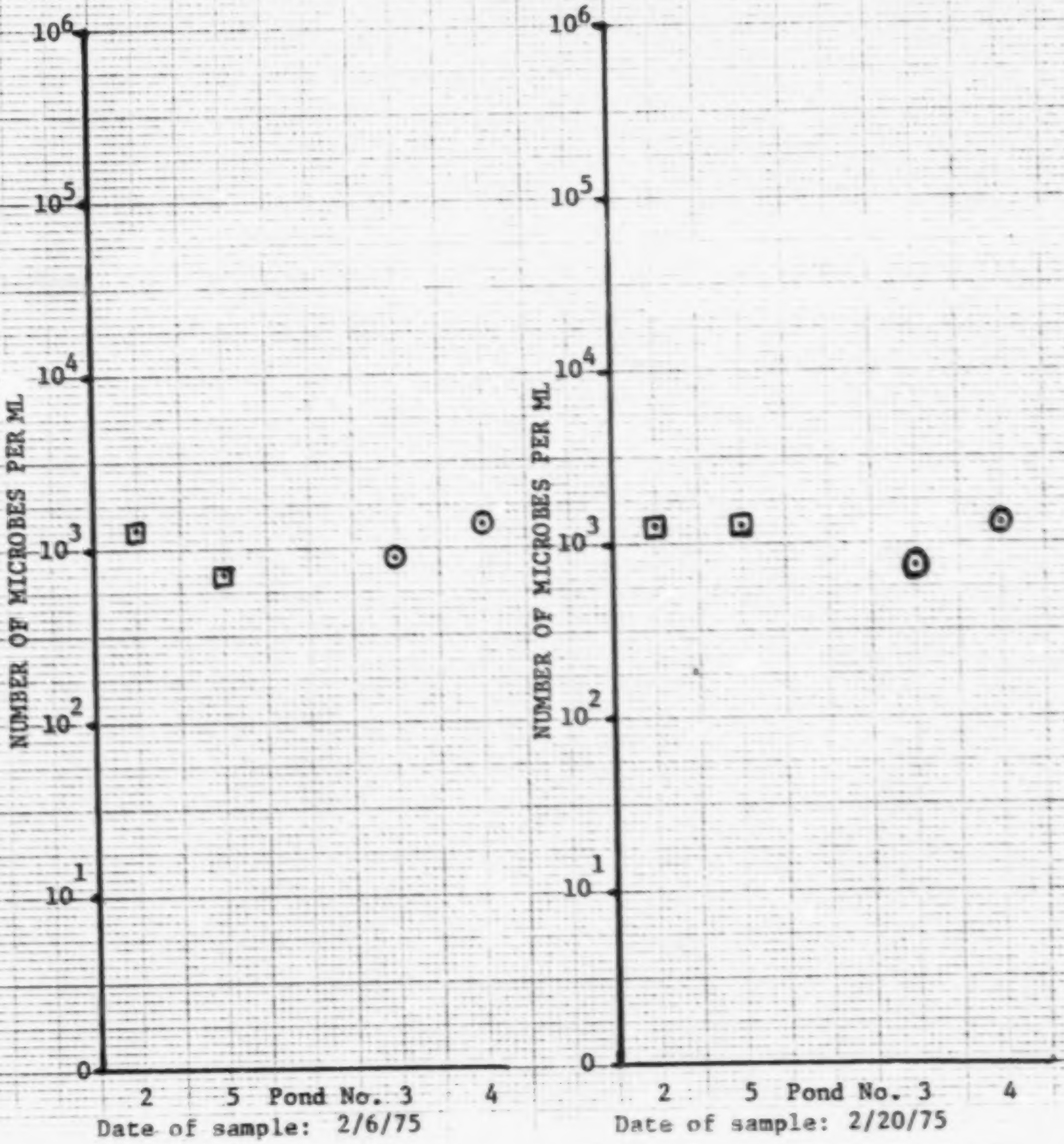


Figure [illegible] - Total number of microbes per ml of pond water as determined on nutrient agar containing 15 ppt salinity.

Item 167

Microbial counts obtained from mud samples taken from the MSU/NSTL ponds. Pre-spill samples - 18 December 1973 and 18 February 1974; Post-spill samples - 17 July 1974 and 12 February 1975.

Sample Collection Date	Pond	Total Plate Count (N.A.)	Yeast (PDA)	Fungi (PDA)	Fungi (RB)	Actino-mycetes (RB)	HU-SR	HU-NR
		No./gm	No./gm	No./gm	No./gm	No./gm	No./gm	No./gm
12/18/73	2	4.2×10^5	10^3	10^3	10^3	10^3	2.8×10^5	2.8×10^6
	5	1.5×10^6	10^3	10^3	10^3	10^3	5.0×10^5	2.8×10^5
	3	1.7×10^6	10^3	10^3	10^3	10^3	2.8×10^6	2.5×10^6
	4	2.0×10^5	10^3	10^3	10^3	10^3	2.8×10^5	2.8×10^6
2/18/74	2	1.5×10^6	10^3	10^3	10^3	10^3	5.0×10^6	5.0×10^7
	5	5.2×10^6	10^3	10^3	10^3	10^3	5.0×10^5	5.0×10^6
	3	1.3×10^6	10^3	5.0×10^3	10^3	10^3	5.0×10^6	5.0×10^5
	4	3.8×10^6	10^3	10^3	10^3	10^3	5.0×10^6	5.0×10^6
7/17/74		1st oil spill in ponds 3 & 4						
7/19/74		2nd oil spill in ponds 3 & 4						
7/26/74	2	8.9×10^5	1.5×10^4	3.0×10^3	10^3	10^3	5.0×10^5	5.0×10^5
	5	7.4×10^5	1.2×10^4	10^3	10^3	10^3	5.0×10^5	5.0×10^5
	3	5.6×10^5	2.9×10^4	2.5×10^3	1.5×10^3	10^3	5.0×10^5	5.0×10^4
	4	2.5×10^5	2.6×10^4	10^3	10^3	10^3	5.0×10^6	5.0×10^3

Sample Collection Date	Pond	Total Plate Count (N.A.)	Yeast (PDA)	Fungi (PDA)	Fungi (RB)	Actino-mycetes (RB)	HU-SR	HU-NR
		No./gm	No./gm	No./gm	No./gm	No./gm	No./gm	No./gm
8/23/74	2	3.6×10^4	1.6×10^4	1.5×10^3	1.0×10^3	1.0×10^3	5.0×10^5	5.0×10^4
	5	9.1×10^5	4.0×10^3	6.5×10^3	6.2×10^4	1.0×10^3	5.0×10^4	5.0×10^4
	3	3.2×10^5	1.8×10^4	2.5×10^3	1.0×10^3	1.0×10^3	5.0×10^5	5.0×10^5
	4	2.7×10^5	1.0×10^3	1.0×10^3	5.5×10^3	1.0×10^3	5.0×10^3	5.0×10^3
9/30/74	2	2.1×10^5	1.5×10^3	1.4×10^4	1.8×10^4	1.0×10^3	5.0×10^4	5.0×10^4
	5	1.6×10^5	2.5×10^3	1.0×10^3	1.0×10^3	1.0×10^3	5.0×10^4	5.0×10^4
	3	1.3×10^6	1.6×10^4	1.0×10^3	1.0×10^3	1.0×10^3	4.0×10^3	4.0×10^3
	4	4.5×10^5	6.5×10^3	1.0×10^3	1.0×10^3	1.0×10^3	5.0×10^5	5.0×10^5
9/30/74	2	9.2×10^5	1.5×10^3	2.5×10^3	1.0×10^3	1.0×10^3	3.8×10^3	3.8×10^3
	5	1.2×10^5	4.5×10^3	1.5×10^3	1.0×10^3	1.0×10^3	5.0×10^4	5.0×10^4
	3	3.4×10^5	8.5×10^3	7.0×10^3	1.0×10^3	1.0×10^3	4.5×10^4	4.5×10^3
	4	1.9×10^5	7.0×10^3	3.0×10^3	1.0×10^3	1.0×10^3	4.6×10^4	4.6×10^4
12/13/74	2	3.5×10^5	6.0×10^3	6.0×10^3	1.0×10^3	1.0×10^3	5.0×10^3	5.0×10^4
	5	8.6×10^5	1.3×10^5	1.0×10^4	1.0×10^3	1.0×10^3	5.0×10^5	5.0×10^4
	3	5.7×10^5	1.6×10^4	1.0×10^3	1.0×10^3	1.0×10^3	1.0×10^4	5.0×10^4
	4	5.7×10^5	1.1×10^5	5.4×10^4	1.0×10^3	1.0×10^3	5.0×10^4	5.0×10^6

Sample Collection Date	Pond	Total Plate Count (N.A.)	Yeast (PDA)	Fungi (PDA)	Fungi (RB)	Actino-mycetes (RB)	HU-SR	HU-NR
		No./gm	No./gm	No./gm	No./gm	No./gm	No./gm	No./gm
2/12/75	2	$2.8x10^5$	$7.5x10^4$	$3.0x10^3$	$1.0x10^3$	$1.0x10^3$	$5.0x10^4$	$5.0x10^6$
	5	$3.6x10^6$	$1.2x10^4$	$2.0x10^3$	$1.0x10^3$	$1.0x10^3$	$5.0x10^4$	$5.0x10^5$
	3	$1.0x10^6$	$2.3x10^6$	$6.5x10^4$	$1.0x10^3$	$1.0x10^3$	$5.0x10^4$	$5.0x10^4$
	4	$1.6x10^5$	$1.7x10^4$	$5.8x10^4$	$1.0x10^4$	$1.0x10^3$	$5.0x10^3$	$1.0x10^3$

Item 168

Planktonic organisms present in water samples from pond 2 from 30 May - 19 July 1974 (pre-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8
Chlorophycophyta								
Closteridium	-	-	-	-	-	2	-	-
Cosmarium	-	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	2	0	0
Chrysophycophyta								
Amphora	-	-	-	-	-	-	-	-
Coscinodiscus	-	-	2	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-	-	-
Navicula	6	11	15	16	11	15	-	13
Nitzxchia closterium	-	-	-	2	4	2	-	-
Nitzschia sp.	9	18	9	6	2	6	-	6
Pleurosigma	-	-	29	10	9	4	6	-
Thalassiosira	-	-	-	-	-	4	-	-
Total	15	29	55	34	26	31	6	19
Cyanophycophyta								
Anabaena	-	2	2	-	7	2	-	4
Anacystis	-	-	-	-	-	-	-	-
Aphanizomenon	-	-	-	-	-	-	-	-
Gleocapsa	373	266	252	300	44	4	28	4
Gomphosphaeria	-	-	-	-	-	-	-	-
Lyngbya	4	7	35	-	13	4	8	2
Oscillatoria	4	28	4	10	18	13	57	7
Total	381	303	293	310	82	23	93	17
Pyrrophycophyta								
Peridinium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
ZOOPLANKTON								
Brachionus (Rotifera)	-	2	174	30	26	136	763	443
Copepod Calanoid (Acartia clausii)	-	-	20	2	20	2	-	-
Copepod nauplius (Acartia)	2	24	61	18	53	4	20	7
Harpactacoid	-	-	2	-	-	-	-	-
Rotifera (Unknown)	-	-	-	-	-	-	-	-
Total	2	26	257	50	99	142	783	450

Column 1 - 5/30/74
Column 2 - 6/6/74
Column 3 - 6/13/74
Column 4 - 6/20/74
Column 5 - 6/27/74
Column 6 - 7/9/74
Column 7 - 7/17/74
Column 8 - 7/19/74

* Initial 3 gallons of oil added
** Additional 3 gallons of oil added

Item 168 (cont.)

Planktonic organisms present in water samples from pond 5 from 30 May - 19 July 1974 (pre-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8
Chlorophycophyta								
Closteridium	-	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
Chrysophycophyta								
Amphora	7	2	-	-	-	-	-	-
Coscinodiscus	-	2	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-	-	-
Navicula	29	24	4	8	2	4	2	13
Nitzxchia closterium	11	15	2	10	18	2	-	-
Nitzschia sp.	129	15	4	22	18	7	12	29
Pleurosigma	7	-	2	2	-	-	-	-
Thalassiosira	-	-	-	-	-	-	-	-
Total	183	58	12	42	38	13	14	42
Cyanophycophyta								
Anabaena	-	-	-	-	7	18	-	4
Anacystis	-	-	-	-	-	-	-	-
Aphanizomenon	-	-	-	2	-	2	-	-
Gleocapsa	2857	828	162	126	97	13	75	11
Gomphosphaeria	-	-	-	-	-	-	-	-
Lyngbya	-	13	22	8	11	24	34	6
Oscillatoria	4	9	4	6	20	202	144	15
Total	2861	850	188	142	135	259	253	36
Pyrrophycophyta								
Peridinium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
ZOOPLANKTON								
Brachionus (*Rotifera*)	-	13	28	14	9	7	79	193
Copepod Calanoid (*Acartia clausii*)	-	-	-	-	7	4	-	2
Copepod nauplius (*Acartia*)	-	2	4	4	18	6	14	7
Harpactacoid	-	2	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	-	-	-	-	-
Total	0	17	32	18	34	17	93	202

Column 1 - 5/30/74
Column 2 - 6/6/74
Column 3 - 6/13/74
Column 4 - 6/20/74
Column 5 - 6/27/74
Column 6 - 7/9/74
Column 7 - 7/17/74
Column 8 - 7/19/74

* Initial 3 gallons of oil added
** Additional 3 gallons of oil added

Item 168 (cont.)

Planktonic organisms present in water samples from pond 3 from 30 May - 19 July 1974 (pre-spill).

PHYTOPLANKTON	1	2	3	4	5	6	*7	**8
Chlorophycophyta								
Closteridium	-	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
Chrysophycophyta								
Amphora	-	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-	-	-
Navicula	2	6	12	2	6	4	2	8
Nitzxchia closterium	-	-	-	-	-	-	6	-
Nitzschia sp.	-	-	4	11	-	6	6	-
Pleurosigma	-	-	-	20	14	2	-	-
Thalassiosira	-	-	-	-	-	-	-	-
Total	2	6	16	33	20	12	14	8
Cyanophycophyta								
Anabaena	-	-	-	9	-	-	13	-
Anacystis	-	4	-	-	-	-	-	-
Aphanizomenon	8	18	8	51	69	2	4	-
Gleocapsa	14	22	105	7	32	215	7	45
Gomphosphaeria	-	-	-	-	-	-	-	-
Lyngbya	-	4	-	33	280	43	20	53
Oscillatoria	2	20	6	354	83	32	121	440
Total	24	68	119	454	464	292	165	538
Pyrrophycophyta								
Peridinium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
ZOOPLANKTON								
Brachionus (Rotifera)	8	6	-	2	2	12	59	22
Copepod Calanoid (*Acartia clausii*)	-	-	-	-	-	-	-	-
Copepod nauplius (*Acartia*)	4	-	-	-	2	6	-	2
Harpactacoid	-	-	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	-	-	-	-	-
Total	12	6	0	2	4	18	59	24

Column 1 - 5/30/74
Column 2 - 6/6/74
Column 3 - 6/13/74
Column 4 - 6/20/74
Column 5 - 6/27/74
Column 6 - 7/9/74
Column 7 - 7/17/74
Column 8 - 7/19/74

* Initial 3 gallons of oil added
** Additional 3 gallons of oil added

Item 168 (cont.)

Planktonic organisms present in water samples in pond 4 from 30 May - 19 July 1974 (pre-spill).

PHYTOPLANKTON	1	2	3	4	5	6	*7	**8
Chlorophycophyta								
Closteridium	-	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0
Chrysophycophyta								
Amphora	-	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-	-	-
Navicula	6	4	4	2	6	6	4	16
Nitzxchia closteriu	-	-	-	-	-	-	-	-
Nitzschia sp.	4	-	-	2	-	-	-	4
Pleurosigma	2	-	2	-	2	-	-	4
Thalassiosira	-	-	-	-	-	-	-	-
Total	12	4	6	4	8	6	4	24
Cyanophycophyta								
Anabaena	-	-	-	2	8	-	208	-
Anacystis	-	-	-	-	-	-	-	-
Aphanizomenon	-	43	138	39	16	12	-	-
Gleocapsa	61	93	97	-	61	63	-	49
Gomphosphaeria	-	-	-	-	-	-	-	-
Lyngbya	-	6	6	84	107	215	73	144
Oscillatoria	4	12	55	327	53	256	1613	698
Total	65	154	296	452	245	546	1894	891
Pyrrophycophyta								
Peridinium	2	-	-	-	-	-	-	-
Total	2	0	0	0	0	0	0	0
ZOOPLANKTON								
Brachionus (Rotifera)	4	-	-	4	18	43	22	39
Copepod Calanoid (*Acartia clausii*)	-	-	-	-	-	-	7	2
Copepod nauplius (*Acartia*)	4	4	-	-	2	10	-	4
Harpactacoid	-	-	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	-	-	-	-	-
Total	8	4	0	4	20	53	29	45

Column 1 - 5/30/74
Column 2 - 6/6/74
Column 3 - 6/13/74
Column 4 - 6/20/74
Column 5 - 6/27/74
Column 6 - 7/9/74
Column 7 - 7/17/74
Column 8 - 7/19/74

* Initial 3 gallons of oil added
** Additional 3 gallons of oil added

Item 169

Planktonic organisms present in water samples from control pond 2 from 22 July - 22 August 1974 (post-spill).

PHYTOPLANKTON	9	10	11	12	13	14	15
Chlorophycophyta							
Closteridium	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0
Chrysophycophyta							
Amphora	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	2	9
Navicula	18	7	9	97	2	2	33
Nitzschia closterium	-	2	-	-	4	2	11
Nitzschia sp.	22	7	-	20	-	-	6
Pleurosigma	4	4	-	8	10	7	2
Thalassiosira	-	-	-	-	-	-	-
Total	44	20	9	125	16	13	61
Cyanophycophyta							
Anabaena	-	4	2	4	-	4	6
Anacystis	-	-	-	-	-	-	-
Aphanizomenon	-	-	-	-	-	-	-
Gleocapsa	16	7	7	10	-	-	20
Gomphosphaeria	-	-	-	-	-	-	-
Lyngbya	-	2	2	-	-	-	2
Oscillatoria	45	7	11	67	38	17	75
Total	61	20	22	81	38	21	103
Pyrrophycophyta							
Peridinium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0
ZOOPLANKTON							
Brachionus (Rotifera)	1535	861	325	229	363	1071	773
Copepod Calanoid (*Acartia clausii*)	6	4	4	10	28	18	50
Copepod nauplius (*Acartia*)	37	35	31	63	35	40	105
Harpactacoid	-	-	-	2	-	-	-
Rotifera (Unknown)	-	-	-	8	4	2	40
Total	1578	900	360	312	430	1131	968

Column 9 - 7/22/74
Column 10 - 7/25/74
Column 11 - 7/29/74
Column 12 - 8/1/74
Column 13 - 8/8/74
Column 14 - 8/15/74
Column 15 - 8/22/74

Item 169 (cont.)

Planktonic organisms present in water samples from control pond 5 from 22 July - 22 August 1974 (post-spill).

PHYTOPLANKTON	9	10	11	12	13	14	15
Chlorophycophyta							
Closteridium	-	2	-	-	-	-	9
Cosmarium	-	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-
Total	0	2	0	0	0	0	9
Chrysophycophyta							
Amphora	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-
Fragilaria	77	-	-	-	-	-	-
Gomphonema	-	-	-	-	2	-	-
Hallamonas	-	-	2	-	-	2	-
Navicula	122	7	6	14	10	2	15
Nitzxchia closterium	107	2	-	-	-	7	4
Nitzschia sp.	174	6	20	4	43	35	11
Pleurosigma	8	-	2	2	4	2	-
Thalassiosira	-	-	-	-	-	-	-
Total	488	15	30	20	59	48	30
Cyanophycophyta							
Anabaena	-	4	-	-	-	2	2
Anacystis	-	-	-	-	-	-	-
Aphanizomenon	-	-	-	-	-	-	-
Gleocapsa	85	13	15	-	45	4	4
Gomphosphaeria	10	-	-	-	-	-	-
Lyngbya	-	6	4	-	-	-	2
Oscillatoria	107	17	11	51	6	29	50
Total	202	40	30	51	51	35	58
Pyrrophycophyta							
Peridinium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0
ZOOPLANKTON							
Brachionus (Rotifera)	32	68	15	41	20	119	99
Copepod Calanoid (*Acartia clausii*)	12	7	-	2	6	4	11
Copepod nauplius (*Acartia*)	4	4	6	18	67	59	51
Harpactacoid	-	-	-	2	-	-	-
Rotifera (Unknown)	-	-	-	2	-	-	18
Total	48	79	21	65	93	181	179

Column 9 - 7/22/74
Column 10 - 7/25/74
Column 11 - 7/29/74
Column 12 - 8/1/74
Column 13 - 8/8/74
Column 14 - 8/15/74
Column 15 - 8/22/74

Item 169 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 3 from 22 July - 22 August 1974 (post-spill).

PHYTOPLANKTON	9	10	11	12	13	14	15
Chlorophycophyta							
Closteridium	-	-	-	-	7	-	2
Cosmarium	2	-	-	-	-	-	-
Pedistrium	-	-	-	-	-	-	-
Total	2	0	0	0	7	0	2
Chrysophycophyta							
Amphora	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-	13
Navicula	13	2	15	15	11	2	17
Nitzxchia closterium	4	-	10	53	73	16	42
Nitzschia sp.	4	-	12	4	7	2	26
Pleurosigma	-	-	6	-	2	2	-
Thalassiosira	-	-	-	-	-	-	-
Total	21	2	43	72	93	22	98
Cyanophycophyta							
Anabaena	79	-	-	26	28	2	28
Anacystis	-	-	-	-	-	-	-
Aphanizomenon	-	4	2	9	2	-	-
Gleocapsa	11	39	15	4	9	-	18
Gomphosphaeria	-	-	-	-	-	-	-
Lyngbya	48	-	-	13	4	4	6
Oscillatoria	1767	773	389	406	193	95	121
Total	1905	816	406	458	236	101	173
Pyrrophycophyta							
Peridinium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0
ZOOPLANKTON							
Brachionus (Rotifera)	4	12	24	9	4	-	-
Copepod Calanoid (Acartia clausii)	-	-	-	-	-	14	24
Copepod nauplius (Acartia)	-	-	-	2	-	138	26
Harpactacoid	-	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	20	17	-	-
Total	4	12	24	31	21	152	50

Column 9 - 7/22/74
Column 10 - 7/25/74
Column 11 - 7/29/74
Column 12 - 8/1/74
Column 13 - 8/8/74
Column 14 - 8/15/74
Column 15 - 8/22/74

Item 169 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 2 from 22 July - 22 August 1974 (post-spill).

PHYTOPLANKTON	9	10	11	12	13	14	15
Chlorophycophyta							
Closteridium	-	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-	2
Pedistrium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	2
Chrysophycophyta							
Amphora	-	-	-	-	-	-	-
Coscinodiscus	-	-	-	-	-	-	-
Fragilaria	-	-	-	-	-	-	-
Gomphonema	-	-	-	-	-	-	-
Mallamonas	-	-	-	2	7	-	2
Navicula	22	4	6	48	13	8	11
Nitzxchia *closterium*	-	-	-	-	11	4	2
Nitzschia *sp.*	7	-	14	-	2	-	2
Pleurosigma	-	-	2	2	-	-	-
Thalassiosira	-	-	-	-	-	-	-
Total	29	4	22	52	33	12	17
Cyanophycophyta							
Anabaena	-	-	-	28	18	2	17
Anacystis	-	-	-	-	-	-	2
Aphanizomenon	4	6	2	9	4	-	-
Gleocapsa	-	14	12	4	11	-	9
Gomphosphaeria	-	-	-	-	-	-	-
Lyngbya	37	-	-	11	6	6	4
Oscillatoria	5639	1320	785	971	347	112	154
Total	5680	1340	799	1023	386	120	186
Pyrrophycophyta							
Peridinium	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0
ZOOPLANKTON							
Brachionus (*Rotifera*)	-	2	43	33	-	4	-
Copepod Calanoid (*Acartia* *clausii*)	-	-	-	-	-	47	29
Copepod *nauplius* (*Acartia*)	-	-	2	4	2	162	18
Harpactacoid	-	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	40	22	6	-
Total	0	2	45	77	24	219	47

Column 9 - 7/22/74
Column 10 - 7/25/74
Column 11 - 7/29/74
Column 12 - 8/1/74

Column 13 - 8/8/74
Column 14 - 8/15/74
Column 15 - 8/22/74

Item 170

Planktonic organisms present in water samples from control pond 2 from 29 August - 21 November 1974 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9
Chlorophycophyta									
Chlorococcum	-	-	-	-	-	-	-	-	-
Closteridium	-	-	-	-	-	-	-	-	-
Pediastrum	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	0
Chrysophycophyta									
Amphora	-	-	-	-	-	-	-	2	-
Mallamonas	-	17	2	-	-	-	11	8	7
Navicula	4	4	28	8	4	6	20	14	9
N. closterium	-	4	-	6	10	-	2	4	-
Nitzschia sp.	4	11	7	10	12	8	9	6	4
Pleurosigma	-	-	-	4	4	2	-	-	2
Surirella	-	-	-	-	-	-	-	-	-
Total	8	36	37	28	30	16	42	34	22
Cyanophycophyta									
Anabaena	-	4	2	-	2	-	2	-	-
Anacystis	6	-	-	-	-	-	-	-	-
Gleocapsa	32	17	2	69	75	24	17	45	2
Gomphosphaeria	-	-	-	-	-	-	-	-	-
Lyngbya	-	2	9	-	8	-	-	-	-
Oscillatoria	37	84	50	97	75	63	37	85	50
Total	75	107	63	166	160	87	56	130	52
ZOOPLANKTON									
Brachionus (Rotifera)	925	288	533	436	351	97	114	128	13
Copepod Calanoid (*Acartia clausii*)	6	31	57	2	24	4	2	28	5
Copepod nauplius (*Acartia*)	20	101	46	31	69	43	35	75	44
Harpactacoid	-	-	-	-	-	-	-	-	-
Rotifera (Unknown)	-	86	156	8	4	12	28	-	9
Total	951	506	792	477	448	156	179	231	71

Column 1 - 8/29/74
Column 2 - 9/ 5/74
Column 3 - 9/12/74
Column 4 - 9/19/74
Column 5 - 9/26/74
Column 6 - 10/10/74
Column 7 - 10/24/74
Column 8 - 11/ 7/74
Column 9 - 11/21/74

Salt added to all ponds on 1/15/74 and 10/16/74

Item 170 (cont.)

Planktonic organisms present in water samples from control pond 5 from 29 August - 21 November 1974 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9
Chlorophycophyta									
Chlorococcum	-	-	-	-	-	-	-	-	-
Closteridium	-	-	-	-	-	-	-	-	-
Pediastrum	-	-	-	-	-	-	-	-	-
Total	0	0	0	0	0	0	0	0	0
Chrysophycophyta									
Amphora	2	-	-	-	4	6	-	18	-
Mallamonas	-	2	-	-	-	-	4	4	-
Navicula	12	-	15	4	6	16	9	24	6
N. closterium	16	2	4	6	14	14	4	42	11
Nitzschia sp.	14	17	20	10	37	37	15	50	9
Pleurosigma	-	-	2	4	-	-	-	2	-
Surirella	-	-	-	-	-	-	-	-	-
Total	34	21	41	24	61	73	32	140	26
Cyanophycophyta									
Anabaena	4	13	-	-	-	-	4	-	-
Anacystis	16	-	-	-	-	14	-	-	-
Gleocapsa	10	20	7	55	85	34	7	26	2
Gomphosphaeria	-	-	-	-	-	-	-	4	-
Lyngbya	-	2	-	-	-	-	7	-	2
Oscillatoria	61	22	29	57	63	67	18	70	42
Total	91	57	36	112	148	115	36	100	46
ZOOPLANKTON									
Brachionus (Rotifera)	45	94	7	10	116	43	20	34	13
Copepod Calanoid (Acartia clausii	-	13	18	6	12	2	6	2	4
Copepod nauplius (Acartia)	26	99	51	97	55	34	20	20	29
Harpactacoid	-	-	-	-	-	-	-	-	-
Rotifera (Unknown)	-	-	-	4	14	8	6	-	2
Total	71	206	76	117	197	87	52	56	48

Column 1 - 8/29/74
Column 2 - 9/ 5/74
Column 3 - 9/12/74
Column 4 - 9/19/74
Column 5 - 9/26/74
Column 6 - 10/10/74
Column 7 - 10/24/74
Column 8 - 11/ 7/74
Column 9 - 11/21/74

Salt added to all ponds on 1/15/74 and 10/16/74

Item 170 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 2 from 29 August - 21 November 1974 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9
Chlorophycophyta									
Chlorococcum	-	-	43	-	-	-	-	-	-
Closteridium	-	-	-	-	-	-	-	-	-
Pediastrum	-	2	-	-	-	-	-	-	-
Total	0	2	43	0	0	0	0	0	0
Chrysophycophyta									
Amphora	2	-	12	-	-	-	-	2	2
Mallamonas	9	-	-	-	6	-	-	4	-
Navicula	6	24	14	4	22	6	8	17	2
N. closterium	2	16	24	9	9	31	32	18	10
Nitzschia sp.	11	18	95	20	24	35	53	50	22
Pleurosigma	-	-	-	-	2	-	-	-	-
Surirella	2	-	-	-	-	-	-	-	-
Total	32	58	145	33	63	72	93	91	36
Cyanophycophyta									
Anabaena	22	6	12	7	26	22	4	37	-
Anacystis	-	-	-	-	-	-	18	-	-
Gleocapsa	24	53	63	15	53	42	28	6	30
Gomphosphaeria	-	2	-	-	-	-	-	-	-
Lyngbya	4	-	-	6	11	7	-	4	-
Oscillatoria	101	99	63	26	119	37	47	108	44
Total	151	160	138	54	209	108	97	155	74
ZOOPLANKTON									
Brachionus (*Rotifera*)	-	37	20	28	22	4	10	8	6
Copepod Calanoid (*Acartia clausii*)	2	4	10	29	22	7	2	9	4
Copepod nauplius (*Acartia*)	59	55	24	202	185	50	18	11	14
Harpactacoid	-	-	-	-	2	-	-	2	-
Rotifera (Unknown)	-	22	-	-	2	4	-	2	-
Total	61	118	54	259	233	65	30	32	24

Column 1 - 8/29/74
Column 2 - 9/ 5/74
Column 3 - 9/12/74
Column 4 - 9/19/74
Column 5 - 9/26/74
Column 6 - 10/10/74
Column 7 - 10/24/74
Column 8 - 11/ 7/74
Column 9 - 11/21/74

Salt added to all ponds on 1/15/74 and 10/16/74

Item 170 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 4 from 29 August - 21 November 1974 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9
Chlorophycophyta									
Chlorococcum	-	-	10	-	-	-	-	-	-
Closteridium	-	-	-	2	-	-	-	-	-
Pediastrum	-	-	-	-	-	-	-	-	-
Total	0	0	10	2	0	0	0	0	0
Chrysophycophyta									
Amphora	-	-	4	-	-	-	14	-	4
Mallamonas	4	-	-	7	2	2	-	13	4
Navicula	11	8	4	6	15	6	10	35	6
N. closterium	-	4	-	-	-	2	12	4	6
Nitzschia sp.	2	6	12	2	4	7	14	26	4
Pleurosigma	-	2	-	-	-	-	4	4	-
Surirella	-	-	-	-	-	2	2	-	-
Total	17	20	20	15	21	19	56	82	24
Cyanophycophyta									
Anabaena	20	-	-	2	4	7	-	7	-
Anacystis	-	-	-	-	-	-	10	-	-
Gleocapsa	26	45	12	46	75	29	43	7	42
Gomphosphaeria	-	2	-	-	-	-	2	-	4
Lyngbya	9	-	-	6	6	9	-	6	-
Oscillatoria	127	118	-	61	77	70	53	7	56
Total	182	165	12	115	162	115	108	27	102
ZOOPLANKTON									
Brachionus (*Rotifera*)	-	34	396	635	101	42	32	26	12
Copepod Calanoid (*Acartia clausii*)	4	2	12	2	13	28	8	4	6
Copepod nauplius (*Acartia*)	48	38	24	62	127	86	22	15	16
Harpactacoid	-	-	-	-	-	-	-	-	-
Rotifera (Unknown)	-	13	14	108	6	4	8	4	-
Total	52	87	446	807	247	160	70	49	34

Column 1 - 8/29/74
Column 2 - 9/ 5/74
Column 3 - 9/12/74
Column 4 - 9/19/74
Column 5 - 9/26/74
Column 6 - 10/10/74
Column 7 - 10/24/74
Column 8 - 11/ 7/74
Column 9 - 11/21/74

Salt added to all ponds on 1/15/74 and 10/16/74

Item 171

Planktonic organisms present in water samples from control pond 2 from 5 December 1974 - 20 February 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Chlorococcum	-	-	-	12	-	-
Cosmarium	-	-	-	-	-	-
Total	0	0	0	12	0	0
Chrysophycophyta						
Amphora	-	-	2	-	-	-
Fragilari	-	-	-	-	-	-
Mallamonas	-	2	-	-	-	-
Navicula	2	2	2	4	6	2
N. closterium	-	-	-	-	-	-
Nitzschia sp.	2	4	2	-	-	4
Pleurosigma	-	-	-	-	-	-
Surirella	-	-	-	-	-	-
Total	4	8	6	4	6	6
Cyanophycophyta						
Anabaena	-	-	-	-	-	-
Anacystis	-	-	-	4	-	-
Gleocapsa	2	6	-	6	18	6
Lyngbya	-	-	-	-	2	-
Oscillatoria	--	14	4	6	2	8
Total	2	20	4	16	22	14
Total Phytoplankton	6	28	10	32	28	20
ZOOPLANKTON						
Brachionus (Rotifera)	9	-	-	6	7	6
Copepod Calanoid (Acartia clausii)	-	-	-	-	7	6
Copepod nauplius (Acartia)	2	-	-	8	29	47
Total Zooplankton	11	-	-	14	43	59

Column 1 - 12/5/74
Column 2 - 12/19/74
Column 3 - 1/9/75
Column 4 - 1/23/75
Column 5 - 2/6/75
Column 6 - 2/20/75

Item 171 (cont.)

Planktonic organisms present in water samples from control pond 5 from 5 December 1974 - 20 February 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Chlorococcum	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-
Total	0	0	0	0	0	0
Chrysophycophyta						
Amphora	2	-	-	2	-	2
Fragilari	-	-	-	6	-	-
Mallamonas	-	-	-	-	-	-
Navicula	9	-	9	8	4	4
N. closterium	6	4	2	65	11	4
Nitzschia sp.	7	2	2	16	5	10
Pleurosigma	-	-	-	4	2	-
Surirella	-	-	-	-	-	-
Total	24	6	13	101	22	20
Cyanophycophyta						
Anabaena	-	-	-	-	4	-
Anacystis	-	-	-	-	-	-
Gleocapsa	-	6	-	6	18	6
Lyngbya	2	-	-	-	-	-
Oscillatoria	4	10	6	16	4	8
Total	6	16	6	22	26	14
Total Phytoplankton	30	22	19	123	48	34
ZOOPLANKTON						
Brachionus (Rotifera)	4	-	2	4	5	6
Copepod Calanoid (Acartia clausii)	-	-	-	-	4	2
Copepod nauplius (Acartia)	4	-	-	4	5	4
Total Zooplankton	8	-	2	8	14	12

Column 1 - 12/5/74
Column 2 - 12/19/74
Column 3 - 1/9/75
Column 4 - 1/23/75
Column 5 - 2/6/75
Column 6 - 2/20/75

Item 171 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 3 from 5 December 1974 - 20 February 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Chlorococcum	-	-	-	-	-	-
Cosmarium	--	2	-	-	-	-
Total	0	2	0	0	0	0
Chrysophycophyta						
Amphora	2	-	-	-	-	-
Fragilari	-	-	-	-	-	-
Mallamonas	-	2	-	-	-	2
Navicula	2	4	-	6	6	9
N. closterium	6	6	2	7	2	4
Nitzschia sp.	-	-	6	4	2	6
Pleurosigma	-	-	-	-	-	-
Surirella	-	-	-	-	-	-
Total	10	12	8	17	10	21
Cyanophycophyta						
Anabaena	-	-	-	4	4	4
Anacystis	-	-	-	-	-	-
Gleocapsa	14	2	12	4	4	4
Lyngbya	4	-	-	2	-	6
Oscillatoria	20	13	16	11	20	15
Total	38	15	28	21	28	29
Total Phytoplankton	48	29	36	38	38	50
ZOOPLANKTON						
Brachionus (Rotifera)	6	-	-	-	4	-
Copepod Calanoid (Acartia clausii)	2	2	-	-	4	2
Copepod nauplius (Acartia)	6	-	4	9	8	7
Total Zooplankton	14	2	4	9	16	9

Column 1 - 12/5/74
Column 2 - 12/19/74
Column 3 - 1/9/75
Column 4 - 1/23/75
Column 5 - 2/6/75
Column 6 - 2/20/75

Item 171 (cont.)

Planktonic organisms present in water samples from Empire Mix-treated pond 4 from 5 December 1974 - 20 February 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Chlorococcum	-	-	-	-	-	-
Cosmarium	-	-	-	-	-	-
Total	0	0	0	0	0	0
Chrysophycophyta						
Amphora	-	-	-	-	2	-
Fragilari	4	-	-	-	-	-
Mallamonas	-	-	-	-	2	2
Navicula	-	6	4	2	-	4
N. closterium	2	2	-	-	2	-
Nitzschia sp.	-	2	6	2	6	4
Pleurosigma	-	-	-	-	-	-
Surirella	2	-	-	-	-	-
Total	8	10	10	4	12	10
Cyanophycophyta						
Anabaena	-	-	-	2	-	2
Anacystis	-	-	-	-	-	-
Gleocapsa	2	13	6	-	4	-
Lyngbya	-	-	-	-	-	2
Oscillatoria	18	9	10	7	14	13
Total	20	22	16	9	18	17
Total Phytoplankton	28	32	26	13	30	27

ZOOPLANKTON	1	2	3	4	5	6
Brachionus (Rotifera)	-	-	2	-	4	-
Copepod Calanoid (Acartia clausii)	-	-	-	2	2	2
Copepod nauplius (Acartia)	4	2	8	9	6	7
Total Zooplankton	4	2	10	11	12	9

Column 1 - 12/5/74
Column 2 - 12/19/74
Column 3 - 1/9/75
Column 4 - 1/23/75
Column 5 - 2/6/75
Column 6 - 2/20/75

Item 172

Planktonic organisms in water samples from pond 2 from 10 March 1975 - 22 May 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Carteria	-	-	-	-	-	-
Total	-	-	-	-	-	-
Chrysophycophyta						
Amphora	-	-	-	-	-	-
Mallamonas	-	-	-	2	4	-
Navicula	7	-	2	4	6	8
N. closterium	-	-	-	-	-	-
Nitzschia sp.	2	4	4	2	4	16
Pleurosigma	-	-	-	-	2	-
Synura	-	-	-	-	-	-
Total	9	4	6	8	16	24
Cyanophycophyta						
Anabaena	2	9	6	4	-	-
Gleocapsa	-	-	-	12	2	-
Comphosphaeria	-	-	-	-	2	-
Lynghya	-	-	4	2	-	-
Merismopedia	-	-	-	-	2	-
Oscillatoria	9	7	22	16	31	6
Total	11	16	32	34	37	6
Total Phytoplankton	20	20	38	42	53	30
ZOOPLANKTON						
Brachionus (Rotifera)	2	-	6	85	649	14
Copepod Calanoid (*Acartia clausii*)	2	2	9	10	8	-
Copepod Nauplius (*Acartia*)	24	6	84	120	241	26
Total Zooplankton	28	8	99	215	898	40

Column 1 - 3/10/75
Column 2 - 3/20/75
Column 3 - 4/10/75
Column 4 - 4/24/75
Column 5 - 5/8/75
Column 6 - 5/22/75

Item 172 (cont.)

Planktonic organisms in water samples from pond 5 from 10 March 1975 - 22 May 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Carteria	-	-	-	-	-	-
Total	-	-	-	-	-	-
Chrysophycophyta						
Amphora	-	-	-	-	-	4
Mallamonas	-	-	-	-	-	-
Navicula	2	7	2	4	12	16
N. closterium	9	15	-	20	4	28
Nitzschia sp.	13	6	4	28	8	604
Pleurosigma	-	-	-	-	-	-
Synura	-	-	-	-	-	-
Total	24	28	6	52	24	652
Cyanophycophyta						
Anabaena	-	4	6	2	-	77
Gleocapsa	-	-	-	8	6	14
Comphosphaeria	-	-	-	-	-	-
Lynghya	7	-	2	-	-	4
Merismopedia	-	-	-	-	-	2
Oscillatoria	7	6	103	4	71	14
Total	14	10	111	14	77	111
Total Phytoplankton	38	38	117	66	101	763
ZOOPLANKTON						
Brachionus (Rotifera)	-	2	2	49	492	16
Copepod Calanoid (Acartia clausii)	-	-	-	2	-	-
Copepod Nauplius (Acartia)	17	7	18	38	156	31
Total Zooplankton	17	9	20	89	648	47

Column 1 - 3/10/75
Column 2 - 3/20/75
Column 3 - 4/10/75
Column 4 - 4/24/75
Column 5 - 5/8/75
Column 6 - 5/22/75

Planktonic organisms in water samples from pond 3 from 10 March 1975 - 22 May 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Carteria	-	-	-	-	-	791
Total	-	-	-	-	-	791
Chrysophycophyta						
Amphora	-	-	-	-	-	-
Mallamonas	-	-	-	-	-	-
Navicula	6	6	4	4	8	2
N. closterium	2	4	2	4	2	-
Nitzschia sp.	4	6	9	10	8	8
Pleurosigma	-	-	-	-	-	-
Synura	2	-	-	-	-	-
Total	14	16	15	18	18	10
Cyanophycophyta						
Anabaena	-	-	7	4	6	4
Gleocapsa	-	-	-	22	6	-
Comphosphaeria	-	-	-	-	10	-
Lynghya	-	-	4	4	-	-
Merismopedia	-	-	-	-	-	-
Oscillatoria	15	7	105	16	24	28
Total	15	7	116	46	46	32
Total Phytoplankton	29	23	131	64	64	833
ZOOPLANKTON						
Brachionus (Rotifera)	2	4	29	51	51	12
Copepod Calanoid (*Acartia clausii*)	-	2	4	8	6	-
Copepod Nauplius (*Acartia*)	7	11	94	71	20	6
Total Zooplankton	9	17	127	130	77	18

Column 1 - 3/10/75
Column 2 - 3/20/75
Column 3 - 4/10/75
Column 4 - 4/24/75
Column 5 - 5/8/75
Column 6 - 5/22/75

Item 172 (cont.)

Planktonic organisms in water samples from pond 4 from 10 March 1975 - 22 May 1975 (post-spill).

PHYTOPLANKTON	1	2	3	4	5	6
Chlorophycophyta						
Carteria	-	-	-	-	-	4
Total	-	-	-	-	-	4
Chrysophycophyta						
Amphora	-	-	-	2	-	-
Mallamonas	2	-	-	4	2	-
Navicula	11	13	6	4	4	10
N. closterium	2	-	2	-	-	2
Nitzschia sp.	-	2	-	2	4	16
Pleurosigma	-	-	-	-	-	-
Synura	-	-	-	-	-	-
Total	15	15	8	12	10	28
Cyanophycophyta						
Anabaena	-	4	-	-	-	4
Gleocapsa	-	7	-	10	10	12
Comphosphaeria	-	-	-	8	22	-
Lynghya	-	-	4	8	-	-
Merismopedia	-	-	-	-	-	2
Oscillatoria	15	13	101	35	8	37
Total	15	24	105	63	40	55
Total Phytoplankton	30	39	113	75	50	87
ZOOPLANKTON						
Brachionus (Rotifera)	4	13	51	327	118	-
Copepod Calanoid (Acartia clausii)	2	4	9	6	-	2
Copepod Nauplius (Acartia)	6	9	165	26	26	2
Total Zooplankton	12	26	225	359	144	4

Column 1 - 3/10/75
Column 2 - 3/20/75
Column 3 - 4/10/75
Column 4 - 4/24/75
Column 5 - 5/8/75
Column 6 - 5/22/75

Item 173

Oil residue data derived from the periodic analysis of tissues from mullet exposed to low levels of Empire Mix crude oil (pond study).

Date	Pond	Gill µg/g	Liver µg/g	Brain µg/g	Muscle µg/g
7/28/74	3*	527	0	0	110
	3	0	0	144	83
	4	0	0	6	25
	4	15	33	89	134
8/12/74	3	7	0	20	0
	4	0	0	0	0
8/19/74	4	1	0	116	46
	3	98	0	67	0
	3	29	0	24	0
	4	0	0	117	0
9/24/74	3	176	0		105
	3	0	0		8
	4	0	0		3
	4	0	0		0
11/6/74	3	0	0		0
	3	0	571		0
	4	0	0		0
	4	0	54		0
1/6/75	4	0	790		21
	4	545	1448		0
	3	0	2032		0
	3	0	2636		73
3/10/75	3	0	0		10
	3	0	0		21
	4	0	0		0
	4	0	0		595
5/5/75	3	0	2051		0
	3	0	1145		606
	4	0	2495		120
	4	0	46		595

*Each entry represents one mullet.

Item 173 (cont.)

Date	Pond	Gill µg/g	Liver µg/g	Brain µg/g	Muscle µg/g
5/28/75	3[*]	-	12,085	0	0
	3	-	0	0	0
	3	-	0	0	0
	3	-	0	4,549	0
	3	-	0	2,184	0
	3	-	0	0	0
	3	-	-	0	0
	3	-	0	1,048	0
	3	-	0	0	0
	3	-	0	3,185	0
	3	-	0	0	0
	3	-	0	0	0
	3	-	0	0	0
	3	-	335	1,874	0
	3	-	2,918	0	0
	3	0	30,293	23,555	305
	3	0	29,262	18,339	636
	3	0	19,189	25,776	0
	3	0	10,844	58,395	0
	3	0	14,448	12,783	0
5/28/75	4	-	0	8,379	1,143
	4	-	0	0	0
	4	-	344	0	0
	4	-	0	0	0
	4	-	3,384	0	0
	4	-	0	0	0
	4	-	0	0	0
	4	-	1,739	0	0
	4	-	2,577	0	0
	4	-	1,926	0	0
	4	-	0	0	0
	4	-	1,582	0	0
	4	-	0	0	0
	4	-	0	1,245	0
	4	0	0	0	0
	4	0	0	0	0
	4	0	0	0	0
	4	0	0	0	0
	4	0	0	23,749	588

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[*] Each entry represents one mullet.

Item 174

Oil residue data derived from the periodic analysis of tissues from shrimp exposed to low levels of Empire Mix crude oil (pond study).

Date	Pond	H P* μg/g	Muscle μg/g
7/28/74	3**	---	5
	3	0	0
	4	0	0
	4	92	0
8/19/74	3	184	0
	3	0	0
	4	0	0
	4	0	0
9/24/74	4	0	0
	4	0	0
	3	21	3
	3	18	0
11/6/74	4	0	-
	4	0	0
	3	0	0
	3	0	-
1/6/75	4	21	208
	4	400	0
	3	65	0
	3	8	0
3/10/75	4	0	0
	4	0	19
	3	0	0

*HP = hepatopancreas

**Each entry = one shrimp

Item 175

Oil residue data derived from the periodic analysis of tissue from oysters exposed to low levels of Empire Mix crude oil (pond study).

Date	Pond	Oil µg/g
7/28/74	3*	10
	3	8
	3	132
	3	62
	3	0
	3	28
	4	81
	4	14
	4	115
	4	9
	4	739
	4	13
8/19/74	3	0
	3	64
	3	0
	3	0
	3	0
	3	0
	4	0
	4	0
	4	0
	4	24
	4	0
	4	0
9/24/74	3	-
	3	219
	3	0
	3	0
	3	-
	3	-
	4	0
	4	43
	4	0
	4	7
	4	0
	4	0

*Each entry represents a portion of one oyster.

Item 175 (cont.)

Date	Pond	Oil µg/g
11/6/74	3	0
	3	0
	3	0
	3	0
	3	5
	3	17
	4	3
	4	0
	4	17
	4	0
	4	0
	4	0
1/6/75	4	0
	4	0

*Each entry represents a portion of one oyster.

Acetylcholinesterase specific activities of muscle homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	356	263	508	782	602	574	891	516
4	466 ± 110	485 ± 148	1449 ± 470	1340 ± 204	632 ± 50	631 ± 23	631 ± 48	612 ± 60
5	1575 ± 754	2254 ± 1631	792 ± 344	1401 ± 811	350 ± 83	1415 ± 917	450 ± 88	1089 ± 608
6	1094 ± 130	1059 ± 17	830 ± 41	906 ± 103	728 ± 51	681 ± 88	495 ± 101	567 ± 145
7	782 ± 47	654 ± 47	1207 ± 409	1221 ± 464	653 ± 89	500 ± 93	1651	597 ± 5
8	893 ± 460	580 ± 98	1346 ± 650	2200 ± 1348	407 ± 68	451 ± 52	301 ± 1	368 ± 60
9	852 ± 391	811 ± 15	662 ± 33	611 ± 124	715 ± 52	697 ± 120	812	647 ± 37
10	413 ± 35	645 ± 138	435 ± 7	578 ± 63	576 ± 181	378 ± 161	969 ± 666	665 ± 203

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[a] Means are the result of two replications.

Acetylcholinesterase specific activities of brain homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	910	228	281	204	189	201	206	206
4	205 ± 29	232 ± 21	402 ± 19	318 ± 32	238 ± 7	171 ± 4	216 ± 6	191 ± 10
5	240 ± 23	198 ± 4	273 ± 41	269 ± 17	118 ± 73	181 ± 51	157 ± 30	194 ± 22
6	326 ± 86	317 ± 42	318 ± 49	354 ± 38	294 ± 84	279 ± 41	205 ± 11	219 ± 33
7	209 ± 25	200 ± 8	162	268 ± 40	168 ± 19	154 ± 15	166	193 ± 16
8	354 ± 119	220 ± 19	159 ± 15	221 ± 30	234 ± 86	159 ± 11	108 ± 12	163 ± 23
9	245 ± 24	167 ± 49	218 ± 19	214 ± 19	181 ± 7	214 ± 10	340 ± 182	185 ± 2
10	216 ± 79	334 ± 80	304 ± 20	370 ± 173	254 ± 19	230 ± 80	183 ± 41	208 ± 4

[a] Means are the result of two replications.

Alkaline phosphatase specific activities of brain homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	2.6 ± 0.1	--	1.0	--	2.5 ± 0.3	--	1.9	--
3	1.4	2.6	1.8	5.4	2.0	3.3	2.8	2.5
4	1.7 ± 0.3	2.8 ± 0.6	1.4 ± 0.7	2.6 ± 0.7	3.4 ± 0.2	2.8 ± 0.3	2.9 ± 0.2	2.7 ± 0.3
5	3.9 ± 0.1	2.8 ± 0.2	2.9 ± 0.3	2.5 ± 0.0	2.5 ± 0.3	2.2 ± 0.0	2.5 ± 0.2	2.5 ± 0.1
6	3.3 ± 0.2	1.9 ± 1.0	4.8 ± 0.1	3.1 ± 0.3	2.4 ± 0.1	2.5 ± 0.1	2.5 ± 0.0	2.9 ± 0.5
7	3.1 ± 1.8	1.9 ± 0.1	0.5	1.3 ± 0.2	1.8 ± 0.3	1.9 ± 0.1	1.4	1.9 ± 0.2
8	1.2 ± 0.3	1.0 ± 0.1	0.5 ± 0.2	1.2 ± 0.3	1.6 ± 0.0	1.7 ± 0.0	1.2 ± 0.2	1.7 ± 0.1
9	0.0	1.1 ± 0.1	0.7 ± 0.1	0.6 ± 0.1	1.3 ± 0.2	1.3 ± 0.1	1.8 ± 0.1	0.7 ± 0.5
10	4.4 ± 1.9	4.1 ± 0.7	4.6 ± 0.7	5.9 ± 2.6	4.3 ± 0.5	3.4 ± 0.5	2.6 ± 0.2	2.9 ± 0.7

[a] Means are the result of two replications.

Alkaline phosphatase specific activities of liver homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	7.1 ± 1.9	--	10.3	--	7.6 ± 5.3	--	9.9	--
3	9.3	7.1	5.8	5.9	6.0	5.3	5.1	5.2
4	5.2 ± 0.1	2.5 ± 0.5	2.2 ± 0.0	2.7 ± 0.7	4.0 ± 0.4	4.7 ± 0.3	3.7 ± 0.6	4.4 ± 0.2
5	3.9 ± 1.5	2.2 ± 0.0	2.6 ± 0.1	2.9 ± 0.7	3.0 ± 0.5	2.5 ± 0.3	2.7 ± 0.4	3.0 ± 0.3
6	3.7 ± 0.1	2.3 ± 0.7	3.3 ± 0.3	2.9 ± 0.1	3.3 ± 0.0	3.3 ± 0.2	3.2 ± 0.3	2.7 ± 0.3
7	4.0 ± 0.1	3.7 ± 0.3	3.2 ± 0.7	2.5 ± 0.4	3.4 ± 0.1	3.0 ± 0.1	2.0 ± 1.9	2.8 ± 0.2
8	2.6 ± 0.1	3.2 ± 0.2	2.7 ± 1.0	3.3 ± 0.1	2.5 ± 0.1	3.0 ± 0.4	2.6 ± 0.8	2.8 ± 0.1
9	3.1 ± 0.7	4.7 ± 0.3	2.4 ± 0.4	2.3 ± 0.3	3.0 ± 0.2	3.0 ± 0.7	3.1 ± 0.4	2.6 ± 0.1
10	6.4 ± 1.2	4.8 ± 0.1	4.2 ± 0.1	6.2 ± 0.6	10.5 ± 1.9	7.2 ± 2.1	9.6 ± 0.7	9.1 ± 1.1

[a] Means are the result of two replications.

Alkaline phosphatase specific activities of gill homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	28.3 ± 11.0	--	24.9	--	20.1 ± 0.9	--	21.8	--
3	11.5	13.0	9.5	9.8	4.8	6.8	7.0	5.4
4	17.1 ± 5.2	20.3 ± 0.8	19.3 ± 0.4	20.1 ± 5.2	9.0 ± 1.1	7.0 ± 0.2	6.1 ± 0.4	9.0 ± 0.7
5	17.4 ± 3.7	13.2 ± 3.7	14.2 ± 0.9	13.3 ± 0.2	5.4 ± 0.5	4.8 ± 0.4	5.3 ± 0.7	5.7 ± 0.7
6	15.7 ± 1.4	11.7 ± 3.3	15.1 ± 0.1	11.1 ± 5.1	5.9 ± 0.1	5.1 ± 0.2	5.8 ± 0.2	6.2 ± 0.2
7	4.4 ± 0.4	6.3 ± 2.1	11.2 ± 1.4	6.7 ± 4.1	5.3 ± 0.4	5.5 ± 0.8	4.4 ± 0.6	4.8 ± 0.8
8	6.5 ± 2.3	11.3 ± 2.4	4.5 ± 1.2	8.6 ± 0.4	3.9 ± 0.2	4.4 ± 0.9	4.5 ± 0.0	3.8 ± 0.2
9	8.5 ± 1.3	6.9 ± 0.6	5.4 ± 1.5	7.6 ± 0.8	4.3 ± 0.3	4.3 ± 0.1	4.7 ± 0.3	4.3 ± 0.6
10	25.7 ± 1.9	22.3 ± 2.0	18.4 ± 1.2	14.9 ± 1.5	7.3 ± 1.3	9.3 ± 3.5	8.4 ± 0.1	8.5 ± 0.2

[a] Means are the result of two replications.

Alkaline phosphatase specific activities of muscle homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	2.6 ± 1.0	--	2.5	--	0.8 ± 0.1	--	0.9	--
3	0.6	2.7	0.3	2.9	0.9	0.8	0.8	0.7
4	1.4 ± 0.6	0.2 ± 0.1	0.7 ± 0.3	0.8	0.9 ± 0.1	0.7 ± 0.1	0.6 ± 0.0	0.9 ± 0.2
5	4.7 ± 3.7	1.9 ± 1.1	2.3 ± 0.2	2.3 ± 0.6	0.7 ± 0.3	0.6 ± 0.1	0.6	0.6 ± 0.0
6	1.3 ± 0.1	1.4 ± 1.0	2.7 ± 0.6	2.8 ± 0.6	0.7 ± 0.0	0.5 ± 0.1	0.6 ± 0.0	0.6 ± 0.1
7	1.8 ± 0.2	1.3 ± 0.6	0.0	0.6 ± 0.2	0.7 ± 0.2	0.5 ± 0.1	0.7 ± 0.0	0.6 ± 0.0
8	0.4 ± 0.1	1.0 ± 0.2	1.1	0.7	0.5 ± 0.0	0.5 ± 0.0	0.5 ± 0.1	0.5 ± 0.1
9	0.2	0.0	0.0	0.0	0.5 ± 0.1	0.3 ± 0.3	0.6 ± 0.1	0.3 ± 0.0
10	5.3 ± 0.2	10.3 ± 3.7	6.3 ± 0.4	7.2 ± 2.2	1.1 ± 0.4	1.5 ± 0.3	1.9 ± 0.9	1.2 ± 0.3

[a] Means are the result of two replications.

β-Glucuronidase specific activities of brain homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	104	118	104 ± 10	122 ± 16	85	73	85 ± 0	60 ± 15
2	402 ± 6	--	181	--	183 ± 24	--	118	--
3	197	164	152	169	90	81	98	77
4	108 ± 44	162 ± 14	94 ± 9	788 ± 729	129 ± 13	88 ± 5	67 ± 2	85 ± 5
5	132 ± 3	100 ± 8	91 ± 6	79 ± 1	50 ± 4	68 ± 7	75 ± 1	79 ± 5
6	184 ± 65	162 ± 10	234 ± 24	195 ± 59	92 ± 4	78 ± 3	97 ± 6	204 ± 92
7	40 ± 17	63 ± 19	22	53 ± 21	28 ± 8	38 ± 1	28	43 ± 4
8	--	--	--	--	--	--	--	--
9	66 ± 21	56 ± 7	75 ± 4	77 ± 3	35 ± 8	49 ± 7	50 ± 10	45 ± 4
10	206 ± 63	281 ± 104	238 ± 21	344 ± 201	129 ± 15	130 ± 49	108 ± 7	135 ± 29

[a] Means are the result of two replications.

β-Glucuronidase specific activities of gill homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	644	671	731 ± 100	795 ± 59	352	413	269 ± 61	222 ± 1
2	1676 ± 447	--	951	--	854 ± 50	--	926	--
3	796	904	683	729	316	276	290	233
4	757 ± 179	759 ± 124	754 ± 60	1062 ± 126	316 ± 59	252 ± 5	208 ± 13	298 ± 32
5	225 ± 139	787 ± 121	482 ± 67	573 ± 51	253 ± 41	248 ± 9	272 ± 26	257 ± 19
6	722 ± 62	978 ± 183	1053 ± 31	561 ± 150	321 ± 6	347	352 ± 15	322 ± 31
7	363 ± 13	521 ± 189	360 ± 22	308 ± 32	154 ± 19	229 ± 74	136 ± 56	159 ± 0
8	--	--	--	--	--	--	--	--
9	398 ± 21	494 ± 119	239 ± 133	530 ± 8	144 ± 20	130 ± 18	149 ± 10	175 ± 4
10	1132 ± 75	981 ± 42	865 ± 55	673 ± 47	255 ± 6	375 ± 133	322 ± 8	397 ± 16

[a] Means are the result of two replications.

β-Glucuronidase specific activities of liver homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	2474	2085	2543 ± 562	1027 ± 264	1425	876	1424 ± 359	1027 ± 264
2	2688 ± 339	--	2520	--	6253 ± 474	--	5033	--
3	3872	3068	3936	2326	1989	2190	2124	2326
4	3515 ± 256	3530 ± 72	1952 ± 104	1598 ± 60	2021 ± 339	2233 ± 31	1072 ± 290	1598 ± 60
5	2546 ± 1203	3491 ± 351	2743 ± 349	1808 ± 162	1254 ± 184	2167 ± 388	2038 ± 250	1808 ± 162
6	2987 ± 213	3671 ± 1087	3067 ± 1	1822 ± 693	1911 ± 357	2123 ± 484	2534 ± 421	1822 ± 693
7	2483 ± 534	3453 ± 424	3031 ± 601	3270 ± 54	781 ± 391	1957 ± 253	2903 ± 92	2171 ± 321
8	--	--	--	--	--	--	--	--
9	2322 ± 520	2619 ± 818	1434 ± 22	2463 ± 116	2521 ± 707	2882 ± 1190	1783 ± 73	2592 ± 298
10	1704 ± 131	2276 ± 468	2976 ± 479	3112 ± 108	3573 ± 275	4378 ± 917	6456 ± 215	5204 ± 3367

[a] Means are the result of two replications.

β-Glucuronidase specific activities of muscle homogenates from mullet in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	67	15	20 ± 7	20 ± 9	39	21	17 ± 5	28 ± 10
2	298 ± 145	--	224	--	78 ± 16	--	66	--
3	3	--	32	21	38	32	37	31
4	14	15	29 ± 1	18 ± 16	26 ± 3	16 ± 9	19 ± 0	28 ± 4
5	64 ± 53	49 ± 43	18 ± 15	51 ± 11	18 ± 1	21 ± 3	24 ± 1	34 ± 6
6	49	36	70 ± 29	53 ± 47	19 ± 1	22 ± 3	34 ± 4	29 ± 9
7	0	5	0	0	10 ± 7	9 ± 1	49 ± 25	14 ± 1
8	--	--	--	--	--	--	--	--
9	51 ± 7	64 ± 0	14 ± 12	21 ± 16	22 ± 6	25 ± 5	23 ± 5	27 ± 6
10	228 ± 8	330 ± 87	307 ± 8	340 ± 112	37 ± 15	51 ± 13	73 ± 46	62 ± 26

[a] Means are the result of two replications.

Malic dehydrogenase specific activities of mullet gill homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	---	2289 ± 329 (6)	---	---	---	2932 ± 433 (6)	---	---
2	---	1591 ± 510 (3)	---	---	---	5960 ± 559 (3)	---	---
3	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---
5	1455 ± 415	1128 ± 157	984 ± 2	991 ± 140	587 ± 310	641 ± 97	634 ± 10	649 ± 41
6	---	---	---	---	---	---	---	---
7	1513 ± 519	1828 ± 285	1165 ± 77	1800 ± 241	736 ± 123	1274 ± 9	897 ± 154	783 ± 219
8	2300 ± 950	1510 ± 54	1233 ± 79	1366 ± 190	724 ± 17	1174 ± 605	1443 ± 60	1208 ± 85
9	3317 ±2532	1129 ± 414	1041 ± 499	1724 ± 132	2554 ± 183	1686 ± 227	1312 ± 111	995 ± 178

[a] Means are the result of two replications except as indicated in parentheses.

Malic dehydrogenase specific activities of mullet brain homogenates in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	---	932 ± 40[b]	---	---	---	3937 ± 337[b]	---	---
2	---	1127 ± 365[c]	---	---	---	4601 ± 531[c]	---	---
3	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---
5	1481 ± 72	755 ± 252	1261 ± 114	915 ± 87	963 ± 29	1244 ± 213	1167 ± 32	1339 ± 215
6	---	---	---	---	---	---	---	---
7	842 ± 257	1022 ± 159	1137	907 ± 199	1422 ± 346	2131 ± 136	1376	1328 ± 366
8	858 ± 134	923 ± 19	1129 ± 148	1149 ± 56	1628 ± 239	1630 ± 315	1874 ± 388	2322 ± 49
9	1246 ± 201	1153 ± 149	2229 ± 1045	1608 ± 92	1193 ± 55	1962 ± 596	1947 ± 228	1210 ± 519

[a] Means are the result of two replications except as indicated

[b] Means are the result of six replications

[c] Means are the result of three replications

Malic dehydrogenase specific activities of mullet liver homogenates in the MSU/NSTL ecosystem ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	---	1655 ± 159[b]	---	---	---	3381 ± 688[b]	---	---
2	---	1492 ± 213[c]	---	---	---	9005 ± 655[c]	---	---
3	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---
5	1497 ± 329	1368 ± 165	1055 ± 228	1047 ± 873	1597 ± 353	1670 ± 508	1552 ± 270	949 ± 173
6	---	---	---	---	---	---	---	---
7	2269	2596 ± 491	2009 ± 803	2122 ± 193	1571 ± 577	3003 ± 85	---	1680
8	2311 ± 143	1817 ± 104	2070 ± 285	2610 ± 124	1346 ± 925	2678 ± 7	2912 ± 573	2568 ± 493
9	966 ± 24	1707 ± 443	2200 ± 204	2349 ± 117	1883 ± 34	2627 ± 849	2009 ± 320	2525 ± 114

[a] Means are the result of two replications except as indicated

[b] Means are the result of six replications

[c] Means are the result of three replications

Malic dehydrogenase specific activities of mullet muscle homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	---	3012 ± 381[b]	---	---	---	5501 ± 498[b]	---	---
2	---	2145 ± 447[c]	---	---	---	3359 ± 728[c]	---	---
3	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---
5	354 ± 88	446 ± 69	776 ± 144	947 ± 300	318	382 ± 303	180 ± 11	354 ± 6
6	701 ± 286	298 ± 34	844	963 ± 193	381 ± 244	118 ± 15	538	511 ± 76
7	1262 ± 162	645 ± 333	699 ± 266	1159 ± 110	479 ± 172	555 ± 27	614 ± 285	521 ± 100
8	1556 ± 133	652 ± 49	1394 ± 319	966 ± 54	612 ± 125	521 ± 23	620 ± 13	657 ± 1
9	966 ± 24	667 ± 30	781 ± 202	897 ± 68	1551 ± 58	1542 ± 636	652 ± 26	665 ± 1

[a] Means are the result of two replications except as indicated

[b] Means are the result of six replications

[c] Means are the result of three replications

Lactic dehydrogenase specific activities of mullet brain homogenates in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	---	632	799	709	---	2207	2195	1982
4	761 ± 55	757 ± 18	879 ± 64	659 ± 36	2320 ± 60	2034 ± 11	2396 ± 245	1975 ± 265
5	1261 ± 267	784 ± 22	882 ± 3	791 ± 39	2143 ± 248	1697 ± 23	1995 ± 159	1863 ± 38
6	1005 ± 154	1008 ± 1	1108 ± 0	979 ± 43	2095 ± 243	2187 ± 200	1997 ± 29	2683 ± 15
7	397 ± 160	584 ± 86	432	589 ± 53	1237 ± 1	1511 ± 97	1580	1279 ± 112
8	747 ± 108	757 ± 58	693 ± 2	732 ± 36	2496 ± 521	1748 ± 169	2033 ± 99	1915 ± 55
9	993 ± 76	835 ± 58	1182 ± 16	1013 ± 54	1766 ± 48	2158 ± 19	2267 ± 94	1701 ± 244

[a] Means are the result of two replications.

Lactic dehydrogenase-specific activities of mullet gill homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	348	370	253	409	1205	758	1083	926
4	541 ± 207	880 ± 252	685 ± 44	483 ± 51	1379 ± 114	1152 ± 70	1147 ± 13	1223 ± 107
5	896 ± 196	692 ± 84	626 ± 54	708 ± 91	1460 ± 458	1069 ± 63	1236 ± 22	1119 ± 19
6	834 ± 32	698 ± 164	578 ± 7	2661 ± 1617	1506 ± 0	1057 ± 44	1188 ± 80	843 ± 677
7	464 ± 72	377 ± 88	412 ± 13	489 ± 40	729 ± 9	912 ± 52	821 ± 12	953 ± 78
8	667 ± 11	444 ± 110	410 ± 27	717 ± 35	1078 ± 37	722 ± 160	1360 ± 88	1026 ± 36
9	622 ± 51	781 ± 82	532 ± 217	451 ± 99	1461 ± 4	1226 ± 100	1116 ± 179	1363 ± 104

[a] Means are the result of two replications.

Lactic dehydrogenase specific activities of mullet liver homogenates in the MSU/NSTL' ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	135	632	137	79	175	2207	123	135
4	110 ± 2	114 ± 6	88 ± 17	91 ± 1	133 ± 3	129 ± 5	124 ± 7	96 ± 4
5	109 ± 36	71.5± 61	78 ± 24	115 ± 1	107 ± 88	80 ± 1	104 ± 6	101 ± 6
6	137 ± 20	182 ± 32	124 ± 20	180 ± 18	146 ± 29	231 ± 87	130 ± 10	142 ± 13
7	127 ± 20	139 ± 9	116 ± 20	90 ± 5	95 ± 5	90 ± 3	152 ± 20	108 ± 18
8	164 ± 20	121 ± 4	82 ± 11	122 ± 1	151 ± 3	141 ± 15	143 ± 18	130 ± 0
9	130 ± 6	133 ± 21	168 ± 4	126 ± 17	156 ± 18	176 ± 17	155 ± 5	139 ± 52

[a] Means are the result of two replications.

Lactic dehydrogenase specific activities of mullet muscle homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	1336	1714	1545	1833	5327	8561	5908	7325
4	2779 ± 639	3378 ± 400	721 ± 412	2775 ± 655	5177 ± 405	6722 ± 43	5674 ± 579	5689 ± 208
5	3743 ± 345	5332 ± 455	4909 ± 830	4998 ± 771	4815 ± 2128	7040 ± 266	6612 ± 678	5060 ± 415
6	5736 ± 1391	5185 ± 202	4492 ± 418	6071 ± 224	6930 ± 771	4543 ± 1654	4582 ± 174	7937 ± 535
7	7839 ± 1194	3568 ± 312	4732 ± 1119	7647 ± 2862	7353 ± 2990	5373 ± 969	10,968 ± 1171	5069 ± 66
8	6411 ± 2657	3047 ± 24	4499 ± 160	4160 ± 663	3462 ± 453	5236 ± 29	5465 ± 22	4917 ± 617
9	3322 ± 214	3074 ± 484	4209 ± 597	2450 ± 906	7342 ± 1823	6355 ± 21	5668 ± 810	5615 ± 551

[a] Means are the result of two replications.

Glutamic pyruvic transaminase specific activities of mullet brain homogenates in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	---	48	29	42	---	52	64	43
4	43 ± 9	43 ± 8	66 ± 12	81 ± 36	78 ± 3	53 ± 4	50 ± 8	57 ± 6
5	71 ± 27	42 ± 8	38 ± 3	13 ± 2	46 ± 4	53 ± 4	79 ± 26	65 ± 7
6	149 ± 52	61 ± 31	73 ± 19	243 ± 74	96 ± 18	86 ± 1	62 ± 5	116 ± 21
7	42 ± 5	24 ± 10	31	48 ± 16	53 ± 4	46 ± 2	40	43 ± 3
8	12 ± 7	8 ± 5	32 ± 11	29 ± 2	56 ± 2	44 ± 2	45 ± 3	47 ± 4
9	34 ± 14	49 ± 15	25 ± 12	31 ± 0	59 ± 1	46 ± 5	60 ± 4	60 ± 3

[a] Means are the result of two replications.

Glutamic pyruvic transaminase specific activities of mullet liver homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	158	48	159	189	269	52	220	216
4	1714 ± 1459	458 ± 244	115 ± 12	299 ± 161	351 ± 15	595 ± 432	201 ± 21	256 ± 33
5	303 ± 9	189 ± 67	159 ± 15	115 ± 16	422 ± 32	277 ± 38	108 ± 83	296 ± 22
6	321 ± 54	164 ± 56	174 ± 39	169 ± 20	428 ± 145	462 ± 86	308 ± 18	295 ± 49
7	280 ± 90	195 ± 65	198 ± 64	243 ± 79	288 ± 8	236 ± 45	227 ± 23	227 ± 10
8	201 ± 6	145 ± 12	157 ± 19	170 ± 4	278 ± 4	233 ± 50	210 ± 14	173 ± 14
9	115 ± 0	92 ± 2	89 ± 13	138 ± 5	287 ± 0	257 ± 56	210 ± 34	217 ± 22

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[a] Means are the result of two replications.

Glutamic pyruvic transaminase specific activities of mullet gill homogenates in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	102	82	62	55	32	29	33	24
4	76 ± 38	62 ± 7	46 ± 4	56 ± 9	30 ± 2	22 ± 1	27 ± 8	24 ± 2
5	75 ± 41	51 ± 15	69 ± 8	62 ± 8	26 ± 4	26 ± 4	23 ± 3	28 ± 3
6	162 ± 43	59 ± 10	118 ± 32	106 ± 6	44 ± 2	39 ± 2	36 ± 5	38 ± 1
7	36 ± 10	47 ± 13	147 ± 83	84 ± 48	21 ± 1	31 ± 4	17 ± 1	29 ± 6
8	73 ± 30	67 ± 3	53 ± 7	47 ± 12	24 ± 2	20 ± 7	27 ± 5	26 ± 4
9	74 ± 14	56 ± 18	55 ± 12	98 ± 16	23 ± 1	28 ± 9	28 ± 0.5	34 ± 2

[a] Means are the result of two replications.

Glutamic pyruvic transaminase specific activities of mullet muscle homogenates in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	25	28	34	57	46	84	34	65
4	16 ± 7	13 ± 0	31 ± 11	19 ± 4	18 ± 3	17 ± 1	16 ± 2	14 ± 2
5	24 ± 8	18 ± 0	30 ± 5	31 ± 6	17 ± 3	13 ± 2	17 ± 1	17 ± 2
6	52 ± 5	48 ± 7	39 ± 8	48 ± 6	28 ± 5	29 ± 2	19 ± 2	23 ± 1
7	53 ± 15	21 ± 7	37 ± 8	48 ± 6	23 ± 5	18 ± 0	36 ± 8	29 ± 2
8	57 ± 23	62 ± 23	45 ± 1	52 ± 10	22 ± 4	23 ± 4	22 ± 4	28 ± 3
9	37 ± 2	28 ± 14	29 ± 6	28 ± 6	41 ± 3	24 ± 10	27 ± 7	41 ± 10

[a] Means are the result of two replications.

Enzyme specific activities[1] and physiological parameters of individual mullet from ponds sampled 20 days subsequent to first oil spill

Parameter[2]	Tissue	Fraction[3]	Control			Oil-Treated		
			Pond 2	Pond 5	Mean	Pond 3	Pond 4	Mean
ALP	gill	m	6.39 ± 1.23(5)	7.20 ± 0.46(5)	6.80 ± 0.64(10)	8.16 ± 1.96(2)	9.24 ± 0.43(5)	8.93 ± 0.56(7)
		s	2.73 ± 0.08(5)	3.88 ± 0.64(5)	3.30 ± 0.36(10)	3.58 ± 0.97(2)	5.13 ± 0.27(5)	4.68 ± 0.40(7)
	liver	m	3.02 ± 9.34(5)?	3.13 ± 0.42(4)	3.07 ± 0.25(9)	2.48 ± 0.39(3)	2.68 ± 0.30(5)	2.61 ± 0.23(8)
		s	2.54 ± 0.11(5)	2.77 ± 0.13(4)	2.64 ± 0.09(9)	2.53 ± 0.05(3)	2.87 ± 0.16(5)	2.75 ± 0.11(8)
	muscle	m	0.08 ± 0.08(5)	0.37 ± 0.19(5)	0.22 ± 0.11(10)	0.04 ± 0.04(3)	2.00 ± 1.46(5)	1.27 ± 0.94(8)
		s	0.35 ± 0.04(5)	0.42 ± 0.02(5)	0.38 ± 0.03(10)	0.38 ± 0.03(3)	0.60 ± 0.07(5)	0.52 ± 0.06(8)
GLU	gill	m	633 ± 59(5)	515 ± 31(5)	574 ± 37(10)	580 ± 92(2)	592 ± 99(5)	589 ± 71(7)
		s	177 ± 9(5)	231 ± 29(5)	204 ± 17(10)	216 ± 59(2)	260 ± 5(5)	247 ± 16(7)
	liver	m	2713 ± 378(5)	1907 ± 478(4)	2355 ± 313(9)	2074 ± 441(3)	2494 ± 336(5)	2336 ± 259(8)
		s	1780 ± 134(5)	1221 ± 203(4)	1532 ± 147(9)	1673 ± 144(3)	2146 ± 350(5)	1969 ± 231(8)
	muscle	m	5 ± 5(5)	13 ± 7(5)	9 ± 4(10)	31 ± 9(3)	34 ± 13(5)	33 ± 8(8)
		s	16 ± 1(5)	16 ± 2(5)	16 ± 1(10)	22 ± 1(3)	32 ± 4(5)	28 ± 3(8)

Parameter[2]	Tissue	Fraction	Control			Oil-Treated		
			Pond 2	Pond 5	Mean	Pond 3	Pond 4	Mean
MDH	gill	m	1527 ± 134(5)	1916 ± 170(5)	1722 ± 121(10)	1868 ± 173(2)	1709 ± 186(5)	1754 ± 137(7)
		s	2112 ± 110(5)	1902 ± 149(5)	2007 ± 94(10)	2803 ± 516(2)	2022 ± 84(5)	2245 ± 192(7)
	liver	m	2069 ± 219(5)	1190 ± 302(4)	1678 ± 229(9)	1109 ± 165(3)	1471 ± 335(5)	1335 ± 218(8)
		s	3734 ± 178(5)	4657 ± 432(4)	4144 ± 257(9)	2779 ± 197(3)	3053 ± 193(5)	2950 ± 141(8)
	muscle	m	1418 ± 7(5)	1190 ± 139(5)	1304 ± 84(10)	2448 ± 1263(3)	2527 ± 343(5)	2497 ± 462(8)
		s	2310 ± 579(5)	518 ± 63(5)	1414 ± 406(10)	2525 ± 502(3)	3307 ± 651(5)	3014 ± 446(8)
CHE	muscle	m	562 ± 66(5)	944 ± 256(5)	753 ± 140(10)	773 ± 188(3)	867 ± 192(5)	832 ± 132(8)
		s	468 ± 48(5)	516 ± 44(5)	492 ± 32(10)	661 ± 113(3)	456 ± 124(5)	533 ± 91(8)
Liver wgt/body wgt			1.28 ± 0.10(5)	1.26 ± 0.07(5)	1.27 ± 0.06(10)	1.74 ± 0.12(3)	1.68 ± 0.16(5)	1.70 ± 0.10(8)
Length/wgt			4.04 ± 0.19(5)	5.34 ± 0.30(5)	4.69 ± 0.27(10)	4.84 ± 0.21(4)	4.88 ± 0.51(5)	4.90 ± 0.35(9)

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[1] Enzyme specific activities are expressed as mU/mg protein, where 1 U is defined as 1 micromole product formed per minute, mean ± SEM (number of replications).

[2] ALP = alkaline phosphatase; GLU = β - glucuronidase; MDH = malic dehydrogenase; CHE = acetylcholinesterase; Liver weight (g)/body weight (g) x 100; Total length (mm)/body weight (g) (total length estimated in 4 of the 5 samples from pond 4 and 3 of the 4 samples from pond 3 because of severe caudal fin erosion.)

[3] m = mitochondrial fraction, that portion of an 800 x g (10 min) supernatant sedimented at 8000 x g for 15 min.
s = supernatant fraction, supernatant of an 8000 x g (15 min) centrifugation.

Alkaline phosphatase specific activities of hepatopancreas homogenates from shrimp in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	18.8 ± 2.9	17.0 ± 0.9	--	--	21.5 ± 1.4	18.8 ± 2.4	--	--
3	--	1.5	--	0.9	--	3.4	--	0.4
4	0.7 ± 0.1	3.7 ± 0.4	1.3 ± 0.3	1.8 ± 1.0	3.5 ± 0.1	7.2 ± 0.5	2.7 ± 0.0	5.2 ± 1.3
5	1.7 ± 0.3	2.9 ± 0.1	1.8 ± 0.4	6.7 ± 0.3	4.2 ± 0.4	3.6 ± 0.1	4.5 ± 0.2	6.0 ± 0.3
6	2.5 ± 0.5	3.6 ± 0.5	5.4 ± 0.6	6.1 ± 1.4	7.3 ± 0.4	6.0 ± 0.5	4.8 ± 0.5	5.5 ± 0.5
7	3.5 ± 0.5	1.8 ± 0.3	3.7 ± 2.2	0.6 ± 0.2	5.6 ± 0.9	3.6 ± 0.0	4.2 ± 0.8	3.2 ± 0.6
8	1.0 ± 0.2	1.0 ± 0.0	0.9 ± 0.1	0.3 ± 0.0	1.0 ± 0.0	1.9 ± 0.2	1.9 ± 0.2	0.7 ± 0.0
9	--	1.5 ± 0.4[b]	0.1	1.8	--	3.0 ± 0.8[b]	1.7	3.8 ± 0.7

[a] Means are the result of two replications except as indicated.

[b] Means are the result of three replications.

Malic dehydrogenase specific activities of hepatopancreas homogenates from shrimp in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	597	318 ± 19	248 ± 129	324 ± 65	13	41 ± 4	47 ± 7	23 ± 8
2	502 ± 19	485 ± 103	--	--	27 ± 3	22 ± 3	--	--
3	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--
5	406 ± 25	187 ± 19	461 ± 235	225 ± 4	1 ± 0	0 ± 0	1 ± 0	0 ± 0
6	--	--	--	--	--	--	--	--
7	64 ± 3	180 ± 58	70 ± 26	274 ± 34	2 ± 1	2 ± 1	1 ± 1	3 ± 1
8	116 ± 57	481 ± 119	228 ± 33	306 ± 5	1 ± 0	4 ± 2	3 ± 1	7 ± 1
9	--	212 ± 32[b]	245	121 ± 63	--	8 ± 2[b]	2	3 ± 1

[a] Means are the result of two replications except as indicated.

[b] Means are the result of three replications.

Glutamic pyruvic transaminase specific activities of hepatopancreas homogenates from shrimp in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2	64 ± 12	61 ± 24	--	--	4 ± 2	5 ± 1	--	--
3	--	36	--	40	--	10	--	9
4	60 ± 20	51 ± 2	60 ± 1	109 ± 18	10 ± 1	10 ± 3	10 ± 0	13 ± 6
5	85 ± 3	47 ± 0	35 ± 8	45 ± 6	6 ± 1	5 ± 2	6 ± 1	6 ± 0
6	89 ± 11	141 ± 4	121 ± 38	167 ± 20	7 ± 2	7 ± 0	8 ± 1	7 ± 0
7	49 ± 11	64 ± 3	42 ± 3	64 ± 17	4 ± 1	4 ± 1	4 ± 0	4 ± 0
8	57 ± 18	64 ± 6	49 ± 10	60 ± 2	11 ± 7	11 ± 2	9 ± 1	18 ± 4
9	--	106 ± 27[b]	91	86 ± 28	--	22 ± 9[b]	9	8 ± 3

[a] Means are the result of two replications, except as indicated.

[b] Means are the result of three replications.

β-Glucuronidase specific activities of hepatopancreas homogenates from shrimp in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	131	140 ± 26	99 ± 26	69 ± 7	432	630 ± 66	352 ± 185	218 ± 23
2	403 ± 78	370 ± 24	--	--	259 ± 43	244 ± 47	--	--
3	--	439	--	451	--	453	--	276
4	83 ± 20	151 ± 55	155 ± 44	58 ± 28	190 ± 17	337 ± 104	230 ± 23	286 ± 104
5	275 ± 201	104 ± 5	35 ± 1	106 ± 3	145 ± 19	170 ± 10	134 ± 7	378 ± 18
6	136 ± 47	185 ± 26	84 ± 21	241 ± 10	665 ± 166	508 ± 128	235 ± 14	633 ± 35
7	116 ± 17	128 ± 27	62 ± 49	46 ± 5	331 ± 7	438 ± 107	127 ± 51	343 ± 58
8	--	--	--	--	--	--	--	--
9	--	367 ± 83[b]	78	28	--	894 ± 120[b]	218	170 ± 50

[a] Means are the result of two replications except as indicated.

[b] Means are the result of three replications.

Lactic dehydrogenase specific activities of hepatopancreas homogenates from shrimp in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3	--	22.5	--	13.0	--	4.2	--	3.9
4	18.8 ± 4.2	7.5 ± 2.0	15.1 ± 0.7	16.4 ± 6.0	3.6 ± 0.1	2.9 ± 0.2	3.1 ± 0.4	2.1 ± 0.4
5	19.8 ± 2.1	17.8 ± 0.8	5.1 ± 1.5	1.7 ± 0.1	1.5 ± 0.4	2.3 ± 0.1	2.1 ± 0.2	12.4 ± 2.7
6	12.8 ± 3.9	18.2 ± 0.3	13.9 ± 3.5	17.3 ± 2.7	1.7 ± 0.2	2.3 ± 0.1	2.4 ± 0.1	3.2 ± 0.8
7	6.1 ± 0.3	8.5 ± 0.4	7.8 ± 0.1	4.9 ± 0.8	0.9 ± 0.0	1.0 ± 0.2	0.8 ± 0.3	2.0 ± 0.0
8	17.0 ± 3.7	16.1 ± 1.1	9.9 ± 1.5	17.5 ± 5.0	1.3 ± 0.4	2.3 ± 1.1	0.8 ± 0.2	2.6 ± 0.3
9	--	27.1 ± 5.6[b]	49.6	17.9 ± 2.7	--	5.0 ± 1.2[b]	3.4	3.1 ± 1.7

[a] Means are the result of two replications, except as indicated.

[b] Means are the result of three replications.

Acetylcholinesterase specific activities of whole body homogenates of oysters in the MSU/NSTL ecosystem research ponds[a].

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
3[b]	22 ± 6	36 ± 13	21 ± 6	49 ± 18	13 ± 2	9 ± 2	16 ± 2	18 ± 8
4	57 ± 9	52 ± 7	72 ± 5	48 ± 4	51 ± 1[e]	21 ± 3	23 ± 3[e]	25 ± 5[e]
5	44 ± 5	54 ± 4	51 ± 9	55 ± 6	14 ± 3	21 ± 4	14 ± 1	17 ± 2
6	43 ± 5	35 ± 5	39 ± 4	40 ± 5	23 ± 2	26 ± 3	25 ± 3	26 ± 2
7	52 ± 6	30 ± 4	54 ± 6	34 ± 5	21 ± 2	16 ± 2	14 ± 1	13 ± 2
8	8 ± 1[c]	21	--	142 ± 101[d]	4 ± 0[c]	5	--	37 ± 20[d]

[a] Means are the result of six replications except as indicated.

[b] Means are the result of three replications.

[c] Means are the result of four replications.

[d] Means are the result of two replications.

[e] Means are the result of five replications.

Alkaline phosphatase specific activities of whole body homogenates of oysters in the MSU/NSTL ecosystem research ponds[a]

	Mitochondrial				Supernatant			
Sampling Number	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2[b]	3.5 ± 0.3	2.7 ± 0.3	2.8 ± 0.5	2.7 ± 0.3	1.1 ± 0.1	1.0 ± 0.2	2.2 ± 0.5	2.8 ± 0.6
3[c]	4.2 ± 0.7	5.0 ± 0.7	3.6 ± 1.1	8.7 ± 3.0	1.9 ± 0.6	1.4 ± 0.2	1.8 ± 0.2	4.0 ± 2.0
4	2.2 ± 0.3	1.2 ± 0.3	1.9 ± 0.3	1.2 ± 0.3[e]	2.0 ± 0.4	1.6 ± 0.3	2.4 ± 0.4	2.0 ± 0.5
5	3.0 ± 0.6	4.4 ± 0.6	3.1 ± 0.8	4.3 ± 1.0	2.8 ± 0.2[e]	3.1 ± 0.7	2.0 ± 0.2	2.5 ± 0.3
6	4.9 ± 0.5	3.5 ± 0.5	3.4 ± 0.6	3.0 ± 0.5	2.8 ± 0.3	2.8 ± 0.2	2.0 ± 0.4	2.0 ± 0.2
7	1.6 ± 0.3[d]	1.0 ± 0.3[d]	1.0 ± 0.3	0.8 ± 0.2	1.8 ± 0.5	1.6 ± 0.2	0.9 ± 0.3	1.4 ± 0.2
8	2.0 ± 0.3[d]	5.7	--	1.9 ± 0.2[f]	1.5 ± 0.5[d]	3.2	--	2.7 ± 0.6[f]

[a] Means are the result of six replications except as indicated.

[b] Means are the result of seven replications.

[c] Means are the result of three replications.

[d] Means are the result of four replications.

[e] Means are the result of five replications.

[f] Means are the result of two replications.

Malic dehydrogenase specific activities of whole body homogenates of oysters in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	632 ± 57[c]	439 ± 36	782 ± 154	646 ± 63[b]	3640 ± 335[c]	3296 ± 389	3188 ± 266	3395 ± 391[b]
2[b]	164 ± 15	299 ± 30	304 ± 47	308 ± 34	840 ± 79	1308 ± 165	1303 ± 163	1991 ± 207
3	--	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--	--
5	526 ± 26	493 ± 35	622 ± 64	644 ± 22	1614 ± 88	1854 ± 302	1644 ± 54	1542 ± 87
6	971 ± 154	649 ± 127	495 ± 47	415 ± 118	1564 ± 146	1708 ± 158	1564 ± 185	1913 ± 267
7	204 ± 17	256 ± 19	261 ± 35	280 ± 11	1288 ± 90	1030 ± 66	1192 ± 74	1010 ± 77
8	335 ± 65[d]	506	--	473 ± 10[e]	1412 ± 61[d]	942	--	1380 ± 68[e]

[a] Means are the result of six replications except as indicated.

[b] Means are the result of seven replications.

[c] Means are the result of five replications.

[d] Means are the result of four replications.

[e] Means are the result of two replications.

Glutamic pyruvic transaminase specific activities of whole body homogenates of oysters in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
2[b]	19 ± 3	24 ± 3	17 ± 2	24 ± 5	31 ± 6	28 ± 7	38 ± 5	40 ± 7
3[c]	46 ± 4	71 ± 16	56 ± 7	64 ± 10	46 ± 10	25 ± 2	49 ± 5	62 ± 33
4	34 ± 3	35 ± 3	54 ± 4	44 ± 4	21 ± 2	27 ± 7	51 ± 6	78 ± 10
5	34 ± 4	30 ± 3	41 ± 11	37 ± 2	24 ± 1	38 ± 9	26 ± 2	18 ± 3
6	60 ± 10	35 ± 3	29 ± 4	23 ± 5	63 ± 7	78 ± 18	50 ± 3	74 ± 9
7	26 ± 3	31 ± 7	27 ± 6	31 ± 3	28 ± 7	40 ± 6	37 ± 4	24 ± 2
8	34 ± 5[d]	48	--	39 ± 2[e]	34 ± 6[d]	48	--	134 ± 14[e]

[a] Means are the result of six replications except as indicated.

[b] Means are the result of seven replications.

[c] Means are the result of three replications.

[d] Means are the result of four replications.

[e] Means are the result of two replications.

β-Glucuronidase specific activities of whole body homogenates of oysters in the MSU/NSTL ecosystem research ponds[a]

Sampling Number	Mitochondrial				Supernatant			
	Pond 2	Pond 5	Pond 3	Pond 4	Pond 2	Pond 5	Pond 3	Pond 4
1	1046	662	728	732	2079	1847	1531	2156
2[b]	1225 ± 146	1068 ± 90	1061 ± 85	1234 ± 110	947 ± 105	922 ± 88	1242 ± 201	1975 ± 227
3[c]	916 ± 169	768 ± 201	933 ± 243	1317 ± 180	2063 ± 201	1222 ± 477	1876 ± 384	3390 ± 1465
4	1652 ± 144	1618 ± 265	1257 ± 117	1780 ± 305	2117 ± 206	2262 ± 181	1863 ± 186	2185 ± 288
5	1182 ± 157	1863 ± 772	1584 ± 260	1371 ± 257	885 ± 132	1668 ± 473	1537 ± 370	1050 ± 189
6	1524 ± 310	943 ± 163	876 ± 158	856 ± 109	2641 ± 298	3089 ± 322	3447 ± 850	5047 ± 680
7	579 ± 120	754 ± 57	957 ± 104[d]	796 ± 96	1880 ± 520[d]	1963 ± 311	2133 ± 422	1726 ± 225

[a] Means are the result of six replications except as indicated.

[b] Means are the result of seven replications.

[c] Means are the result of three replications.

[d] Means are the result of five replications.

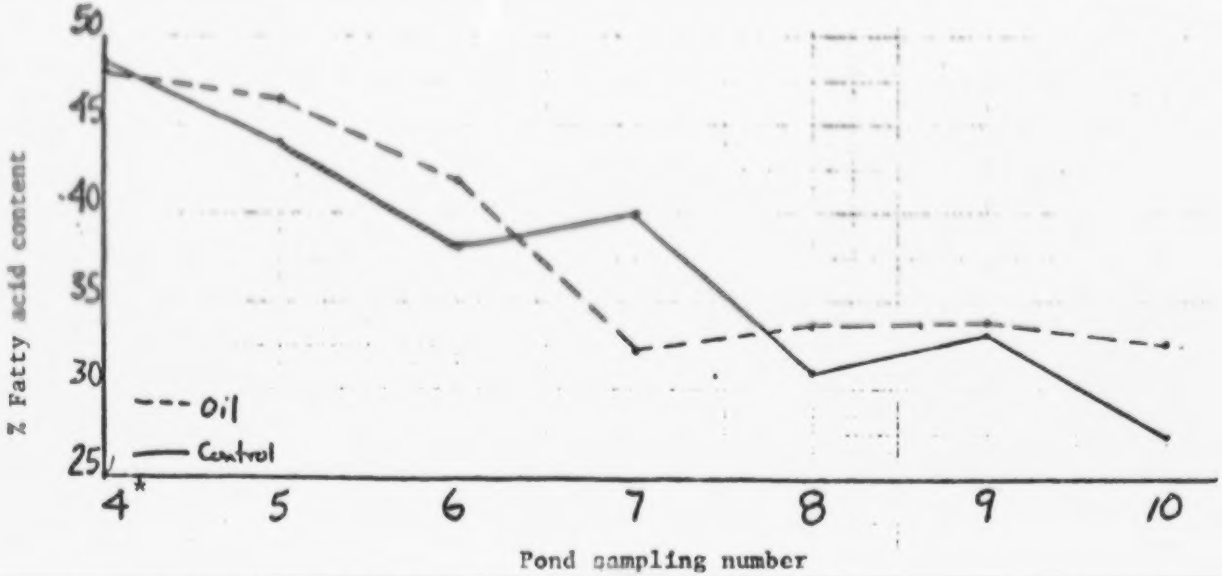
Item 209

Mullet Liver - Total Saturated Fatty Acids

For Oil-Exposed and Control Tissue, Expressed as Percent Composition

Oil Exposed	76.7	76.3	71.7	58.2	65.0	64.5	65.8
Control	73.9	74.4	64.4	71.0	61.0	65.5	60.3
Pond Studies	4	5	6	7	8	9	10

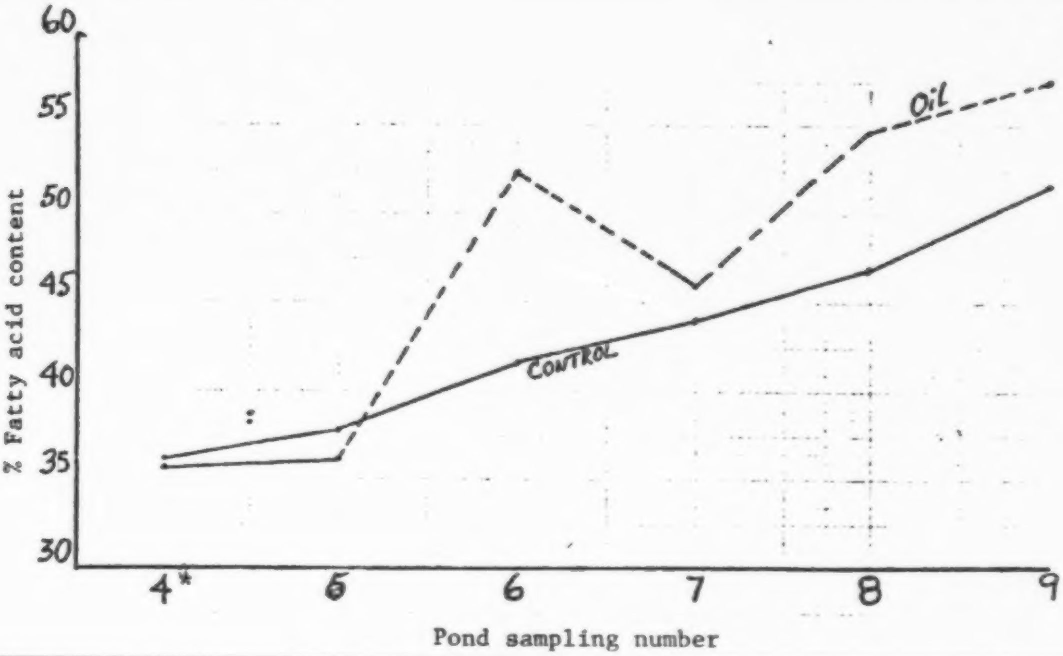
Graphic representation of % content of fatty acid 16:0 in liver samples from mullet exposed to Empire Mix crude oil under pond conditions.



* Numbers 4-10 represent sampling periods spanning approximately 11 months.

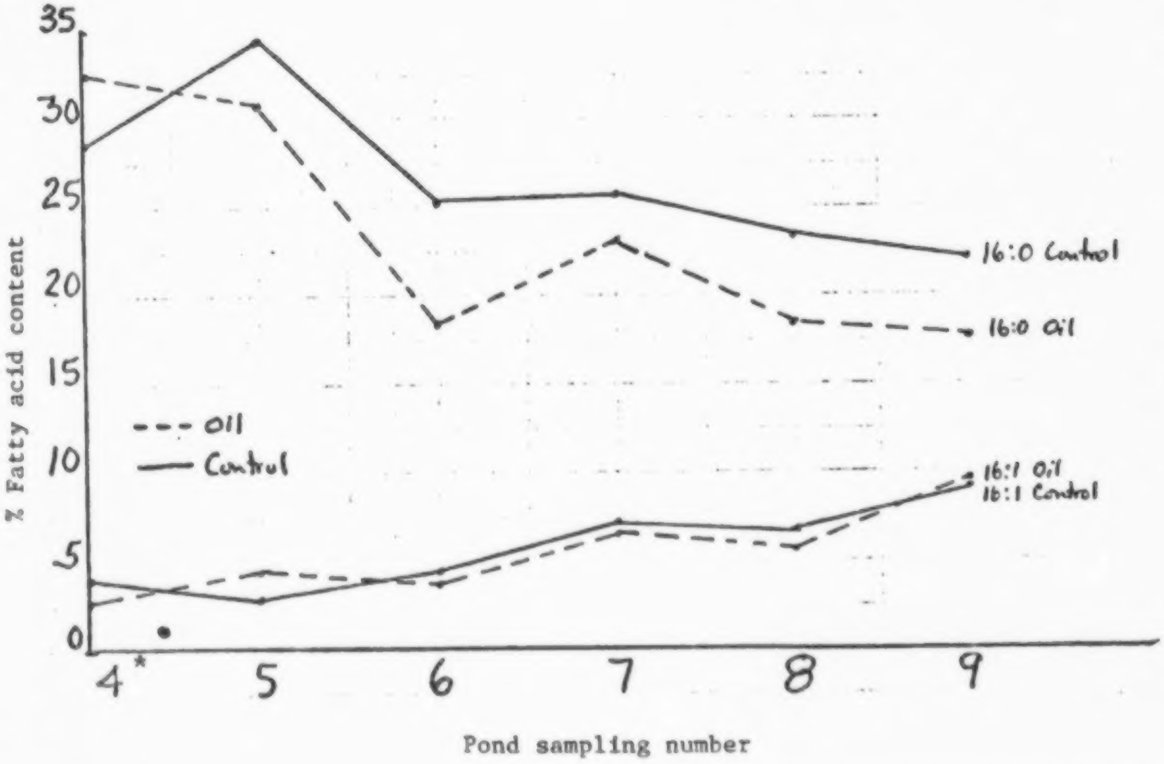
Item 211

Graphic representation of the % content of 1-6 double bonded fatty acids in muscle samples from shrimp exposed to Empire Mix crude oil under pond conditions.



*Numbers 4-9 represent sampling periods spanning approximately 11 months.

Graphic representation of the % content of fatty acids 16:0 and 16:1 in muscle samples from shrimp exposed to Empire Mix crude oil under pond conditions.



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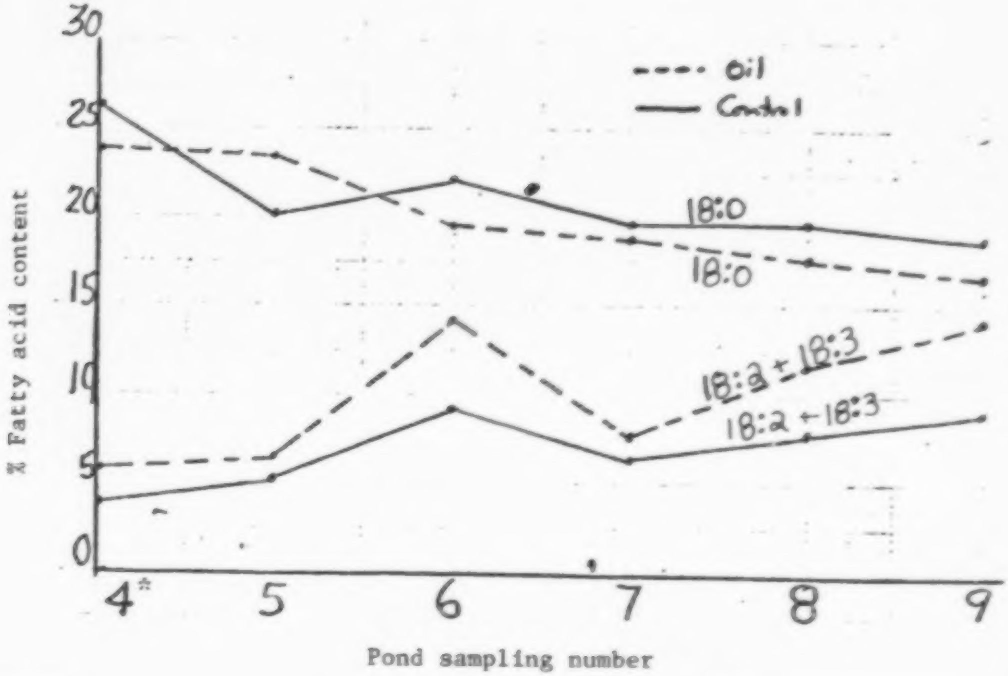
*Numbers 4-10 represent sampling periods spanning approximately 11 months.

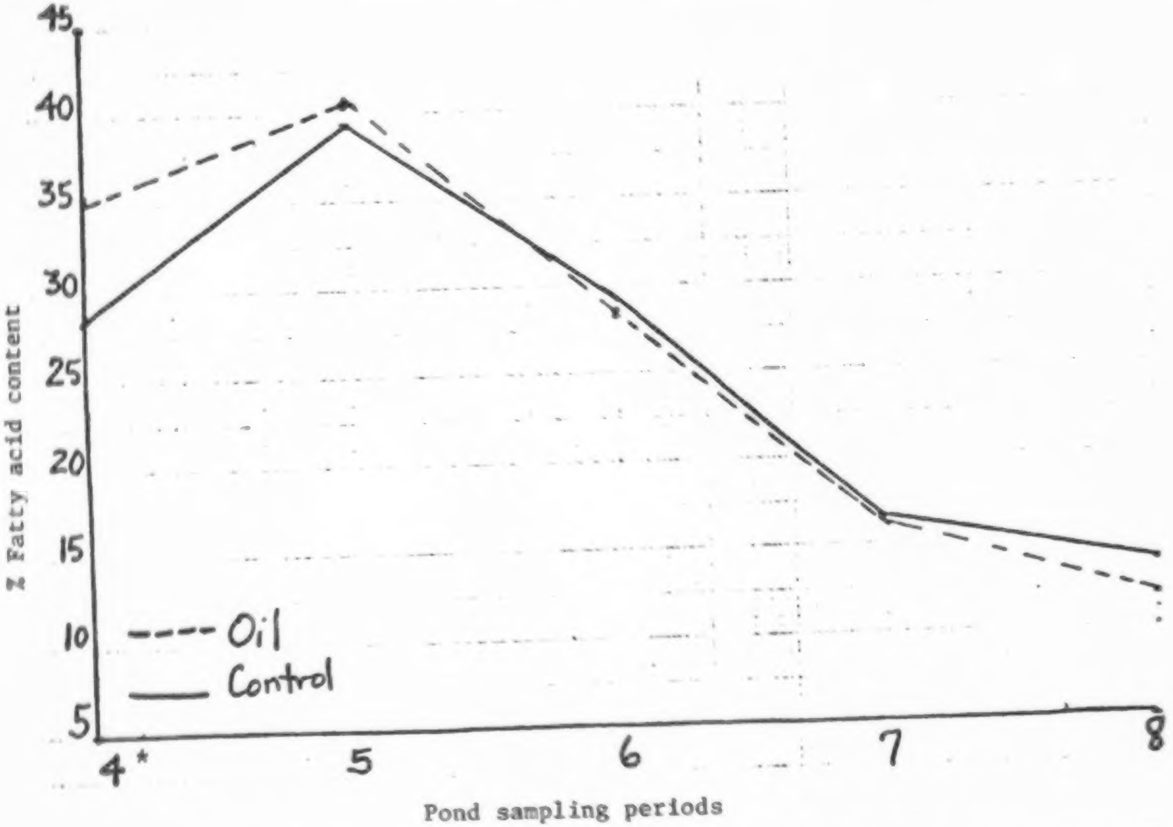
Item 213

Graphic representation of the % content of fatty acids 18:0, 18:2 and 18:3 in muscle samples from shrimp exposed to Empire Mix crude oil under pond conditions.



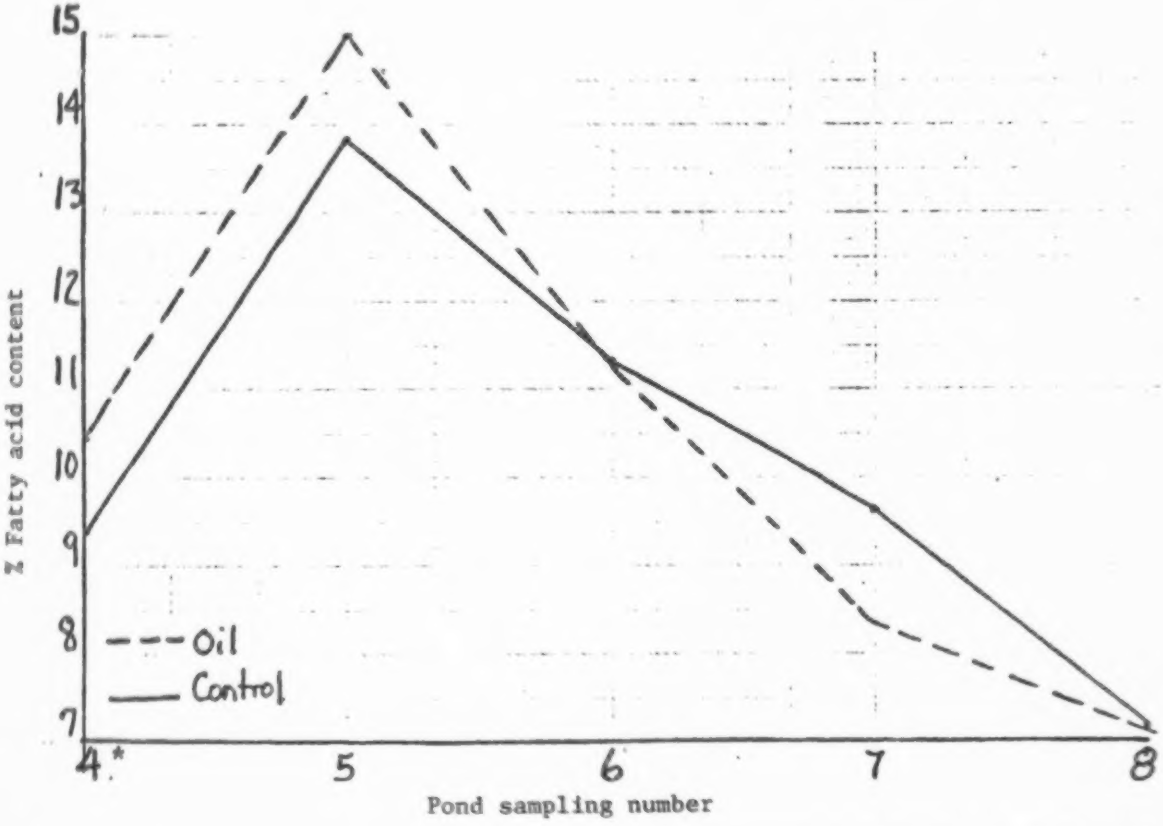
*Number 4-10 represent sampling periods spanning approximately 11 months.

Graphic representation of the % content of fatty acid 16:0 in whole body samples of oysters exposed to Empire Mix crude oil under pond conditions.



*Numbers 4-8 represent sampling periods spanning approximately 8 months.

Graphic representation of % content of fatty acid 18:0 in whole body samples of oysters exposed to Empire Mix crude oil under pond conditions.

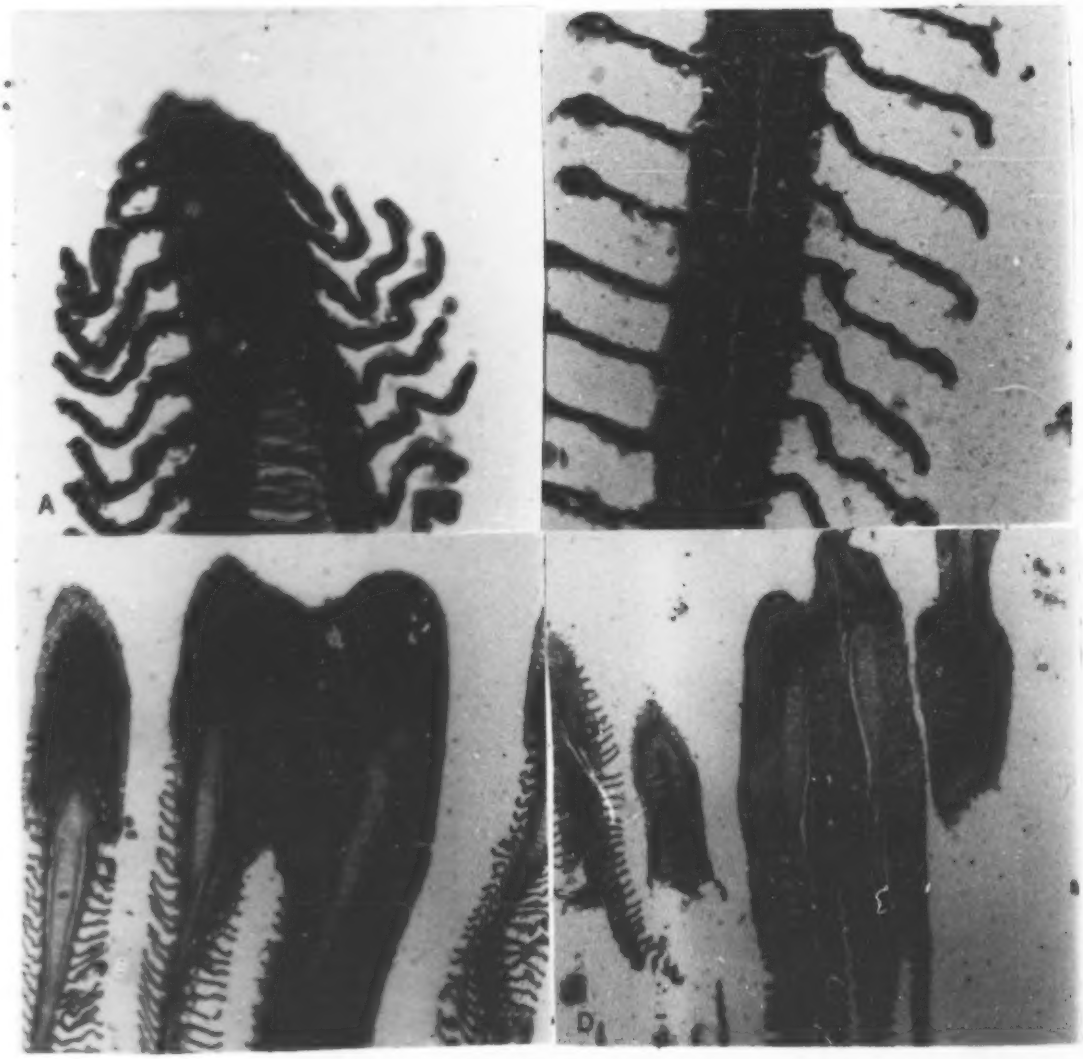


*Numbers 4-8 represent sampling periods spanning approximately 8 months.

Item 216

Percent composition of saturated fatty acids from chronically oil-exposed and control oysters.

Oil Exposed	52.67	66.53	47.63	30.15	23.89
Control	46.65	62.72	50.97	32.24	26.67
Pond Studies	4	5	6	7	8



Gill tissue from mullet harvested after 11 months in Pilot-plant ecosystem ponds. A, B Control. C,D from ponds given a one time treatment with 4 ppm Empire Mix crude oil. Note: Clubbed tips and fused filaments in the gills from the treated mullet.

Item 218

Percent incidence of fin rot in mullet from control and oil contaminated ponds taken during 4 pre-spill and 4 post-spill sampling periods.

Pond 2						Pond 5					
Date	Number Examined	Number Infected	% Infected	Number with Regenera.	% With Regenera	Date	Number Examined	Number Infected	% Infected	Number With Regenera.	% With Regenera.
2-12-74	1	0	0	0	0	2-12-74	3	0	0	0	0
2- 7-74	6	0	0	0	0	2- 7-74	2	0	0	0	0
4-18-74	3	0	0	0	0	4-18-74	3	0	0	0	0
6-10-74	6	0	0	0	0	6-10-74	6	0	0	0	0
7-29-74*	10	1	10	0	0	7-30-74*	10	1	10	0	0
8- 7-74*	5	1	20	0	0	8- 7-74*	5	0	0	0	0
8-13-74*	5	0	0	0	0	8-13-74*	5	0	0	0	0
8-20-74*	10	0	0	0	0	8-20-74*	10	1	10	0	0
Total	46	2	4%			Total	44	2	4.6%		
Tot.Pre-Sp.	16	0	0			Pre-Spill	14	0	0		
Tot.Post-Sp.	30	2	6.7%			Post-Spill	30	2	6.7%		
Pond 3						Pond 4					
2-12-74	3	0	0	0	0	2-12-74	3	0	0	0	0
2- 7-74	6	0	0	0	0	2- 7-74	2	0	0	0	0
4-18-74	3	0	0	0	0	4-18-74	3	0	0	0	0
6-10-74	6	0	0	0	0	6-10-74	6	0	0	0	0
7-30-74*	10	10	100	0	0	7-30-74*	10	10	100	0	0
8- 7-74*	4	3	75	0	0	8- 7-74*	5	5	100	0	0
8-13-74*	5	5	100	3	60	8-13-74*	5	5	100	4	80
8-20-74*	10	10	100	5	50	8-20-74*	10	9	90	7	70
Total	47	28	0	0	0	Total	44	0	0	0	0
Tot.Pre-Sp.	18	0	0	0	0	Pre-Spill	14	0	0	0	0
Tot.Post-Sp.	29	28	97%	8	27.6%	Post-Spill	30	29	97%	11	37%

*Post-spill sampling dates (Spill occurred 7-17-74)

Comparison of the severity and site of infection of fin rot observed in individual fish examined during 4 post-spill sampling periods.

Pond 3

7-29-74

Fish No.	1	2	3	4	5	6	7	8	9	10
C	+++ ++	+++ ++	+++ ++	+++ ++	+++ ++	+++ ++	+++ +	+++ +	+++ +	+++
P1	+++ ++	+++ ++	+++ ++	+++ ++	+++	+++ +	+++ +	+++	-	+++
P2	+++ ++	+++ ++	+++	-	++	-	-	-	-	-

8-7-74

Fish No.	1	2	3	4
C	+++ ++	+++	+++	-
P1	+++ +	+++	++	-
P2	+++			

8-13-74

Fish No.	1	2	3	4	5
C	+++ ++	+++ +	+++ +	+++	+++
P1	+++ ++	+++ +	++	++	-
P2	++	-	-	-	-

8-20-74

Fish No.	1	2	3	4	5	6	7	8	9	10
C	+++ +	+++ +	+++	+++	+++	+++	+++	++	+	+
P1	-	-	+++	+++	++	-	-	-	++	-
P2	-	-	-	-	-	-	-	-	-	-

Pond 4

7-29-74

Fish No.	1	2	3	4	5	6	7	8	9	10
C	+++ ++	+++ ++	+++ ++	+++ ++	+++	+++	+++	+++	+	+
P1	+++ ++	+++ ++	+++ ++	+++	-	-	+++ +	-	-	-
P2	++	-	-	-	-	-	++	-	-	-

8-7-74

Fish No.	1	2	3	4	5
C	+++ ++	+++ +	+++	+++	++
P1	+++ ++	++	++	-	-
P2	+++ ++	-	-	-	-

8-13-74

Fish No.	1	2	3	4	5
C	+++ ++	+++ +	+++	+++	++
P1	++	+++	++	++	+++
P2	-	-	-	-	-

8-20-74

Fish No.	1	2	3	4	5	6	7	8	9	10
C	+++ ++	+++ +	+++ +	+++ +	+++	+++	++	++	+	-
P1	++	+++	++	-	++	-	++	-	-	-
P2	-	-	-	-	-	-	-	-	-	-

C = Caudal Fin P1 = Pectoral Fin P2 = Pelvic Fin

Item 220

Count of hemolytic organisms in pond water thirteen days after the oil spill.

Sample	Total Count* No./ml	Hemolytic Count* No./ml	Percent Hemolytic
Pond 2 (control)	460	110	24
Pond 5 (control)	440	100	23
Pond 3 (oil)	580	230	40
Pond 4 (oil)	1830	1000	55

*24-hour counts.

Item 221

Gravimetric data obtained from the analysis of sediment samples from the MSU/NSTL control pond (Pond Study 2).

	Prespill	Post spill		
	6/24/75	7/29/75		10/6/75
Dry weight	57.9g	432.g	560.g	361.g
Lipid weight	0.0480g	0.1560g	0.1720g	0.2000g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.00345	0.00099	0.00105	0.00222
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	4.17000	2.76000	3.43000	4.00000
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.08280	0.23100	0.03070	0.55400
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.00138	0.00053	0.00048	0.00163
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	1.67000	1.47000	1.57000	2.66000
Percent $\frac{\text{Polar lipids}}{\text{dry weight}}$	0.01190	0.00493	0.00577	0.01110
Percent $\frac{\text{Polar lipids}}{\text{lipid weight}}$	14.30000	13.70000	18.80000	20.10000

Item 222

Gravimetric data obtained from the analysis of sediment samples collected from the MSU/NSTL Saudi Arabian treated pond (Pond Study 2).

	Prespill	Post spill		
	6/27/75	7/29/75		10/6/75
Dry weight	126.g	450.g	440.g	396.g
Lipid weight	0.1420g	0.1520g	0.1820g	0.2220g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.02150	0.10100	0.00493	0.00830
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	1.90000	29.90000	11.90000	14.80000
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.11300	0.03770	0.04140	0.56100
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.00175	0.00340	0.00161	0.01220
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	1.54000	10.1000	3.90000	21.80000
Percent $\frac{\text{Polar lipids}}{\text{dry weight}}$	0.01020	0.01390	0.01040	0.01910
Percent $\frac{\text{Polar lipids}}{\text{lipid weight}}$	9.08000	41.10000	25.20000	34.10000

Item 223

Gravimetric data obtained from analysis of sediment samples collected from MSU/NSTL Nigerian treated pond (Pond Study 2).

	Prespill	Post spill		
	6/24/75	7/29/75		10/6/75
Dry weight	81.2g	504.g	399.g	387.g
Lipid weight	0.0800g	0.3660g	0.4330g	0.3620g
Percent Hydrocarbon/dry weight	0.00332	0.00603	0.00113	0.02160
Percent Hydrocarbon/lipid weight	3.38000	8.31000	1.07000	23.20000
Percent Lipid weight/dry weight	0.09840	0.07260	0.10600	0.09350
Percent Aromatics/dry weight	0.00258	0.01130	0.00288	0.00548
Percent Aromatics/lipid weight	2.62000	15.60000*	2.73000	5.86000
Percent Polar lipids/dry weight	0.01380	0.00115	0.01350	0.01500
Percent Polar lipids/lipid weight	14.10000	1.58000	12.80000	16.10000

Item 224

Gravimetric data obtained from analysis of sediment samples collected from MSU/NSTL Empire Mix treated pond (Pond Study 2).

	Prespill	Post spill		
	6/24/75	7/29/75		10/6/75
Dry weight	125.g	335.g	384.g	326.g
Lipid weight	0.1540g	0.2560g	0.2840g	0.3360g
Percent $\frac{\text{Hydrocarbon}}{\text{dry weight}}$	0.02540	0.00567	0.00159	0.00828
Percent $\frac{\text{Hydrocarbon}}{\text{lipid weight}}$	20.80000	7.42000	2.15000	8.04000
Percent $\frac{\text{Lipid weight}}{\text{dry weight}}$	0.12300	0.07640	0.07380	0.10300
Percent $\frac{\text{Aromatics}}{\text{dry weight}}$	0.00214	0.00281	0.00148	0.01090
Percent $\frac{\text{Aromatics}}{\text{lipid weight}}$	1.75000	3.67000	2.01000	10.60000
Percent $\frac{\text{Polar lipids}}{\text{dry weight}}$	0.01480	0.00985	0.01100	0.02210
Percent $\frac{\text{Polar lipids}}{\text{lipid weight}}$	12.10000	12.90000	14.90000	21.40000

Phytoplankton counts (in org/l) obtained from the MSU/NSTL control ponds during pond study 2.

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9	10	11	12	13
Chlorophycophyta													
Closteridium	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysophycophyta													
Amphora	-	-	-	-	-	-	4	-	-	2	6	2	-
Melosira	-	-	-	-	-	-	20	8	43	53	71	28	120
Navicula	-	-	-	-	-	6	8	4	4	-	2	2	2
Nitzschia sp.	-	-	6	-	6	6	12	4	6	6	12	12	10
N. closterium	-	-	-	-	-	-	-	-	-	-	2	-	-
Pleurosigma	6	-	-	-	-	-	-	-	-	-	-	-	4
Total	6	-	6	-	6	12	44	16	53	61	93	44	136
Cyanophycophyta													
Anabaena	12	-	6	-	6	19	-	-	-	2	-	-	-
Anacystis	-	-	-	-	-	-	-	-	-	-	-	-	-
Gleocapsa	-	-	-	-	-	-	28	16	-	18	6	20	10
Gomphospaeria	-	-	-	-	-	-	-	-	-	-	-	2	-
Lyngbya	-	-	-	-	-	-	-	-	-	-	-	-	-
Oscillatoria	12	6	19	12	31	31	16	12	18	31	20	4	22
Total	24	6	25	12	37	50	44	30	18	51	26	26	32
Total Phytoplankton	30	6	31	12	43	62	88	46	71	112	119	70	168
ZOOPLANKTON													
Brachionus (Rotifera)	144	488	301	113	138	789	69	158	258	99	114	69	55
Copepod Calanoid (Acartia tonsa)	44	38	50	19	12	19	24	12	10	10	4	4	-
Copepod Nauplius (Acartia)	94	157	88	150	50	44	28	20	45	49	47	10	14
Total Zooplankton	282	683	439	272	200	852	121	190	313	158	165	83	69

Column 1 - 6/4/75
Column 2 - 6/11/75
Column 3 - 6/18/75
Column 4 - 6/25/75
Column 5 - 7/2/75
Column 6 - 7/9/75
Column 7 - 7/16/75
Column 8 - 7/23/75
Column 9 - 7/28/75
Column 10 - 7/30/75
Column 11 - 8/1/75
Column 12 - 8/4/75
Column 13 - 8/12/75

Phytoplankton counts (in org/1) obtained from the MSU/NSTL Saudi Arabian treated pond during pond study 2.

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9	10	11	12	13
Chlorophycophyta													
Closteridium	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysophycophyta													
Amphora	-	-	-	-	-	-	-	-	-	4	8	4	-
Melosira	-	-	-	-	-	-	40	16	18	34	10	2	4
Navicula	-	6	-	-	-	6	4	8	4	4	2	2	4
Nitzschia sp.	6	-	-	-	-	-	8	12	14	10	4	8	4
N. closterium	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma	-	-	6	-	-	-	-	-	2	4	-	-	4
Total	6	6	6	-	-	6	52	36	38	56	24	16	16
Cyanophycophyta													
Anabaena	-	-	-	-	12	-	-	-	4	8	-	-	-
Anacystis	-	-	-	-	-	-	-	-	6	22	--	-	-
Gleocapsa	-	-	-	-	-	-	53	24	24	16	18	31	47
Gomphospaeria	-	-	-	-	-	-	-	-	-	-	4	2	4
Lyngbya	-	-	-	-	-	-	-	-	-	-	2	-	-
Oscillatoria	19	12	38	38	31	25	32	28	28	34	10	4	8
Total	19	12	38	38	43	25	85	52	62	80	34	37	59
Total Phytoplankton	25	18	44	38	43	31	137	88	100	136	58	53	75
ZOOPLANKTON													
Brachionus (Rotifera)	19	31	6	100	188	419	453	178	1229	562	203	225	647
Copepod Calanoid (Acartia tonsa)	50	25	25	6	44	-	12	8	32	31	4	8	32
Copepod Nauplius (Acartia)	50	38	19	6	94	6	20	16	99	77	91	45	61
Total Zooplankton	119	94	50	112	326	425	485	202	1360	670	298	278	740

Column 1 - 6/4/75
Column 2 - 6/11/75
Column 3 - 6/18/75
Column 4 - 6/25/75
Column 5 - 7/2/75

Column 6 - 7/9/75
Column 7 - 7/16/75
Column 8 - 7/23/75
Column 9 - 7/28/75
Column 10 7/30/75

Column 11 - 8/1/75
Column 12 - 8/4/75
Column 13 - 8/12/75

Phytoplankton counts (in org/l) obtained from the MSU/NSTL Nigerian Crude treated pond during pond study 2.

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9	10	11	12	13
Chlorophycophyta													
Closteridium	-	-	-	-	-	6	-	-	-	-	-	-	
Total	-	-	-	-	-	6	-	-	-	-	-	-	
Chrysophycophyta													
Amphora	-	-	-	-	-	-	4	-	2	-	-	2	
Melosira	-	-	-	-	-	-	12	20	37	93	31	14	4
Navicula	-	-	-	-	-	19	8	4	4	4	2	4	
Nitzschia sp.	-	-	-	-	-	-	12	-	8	8	10	20	10
N. closterium	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma	-	6	-	-	-	-	-	-	-	-	-	-	-
Total	-	6	-	-	-	19	36	24	51	105	43	40	63
Cyanophycophyta													
Anabaena	12	6	-	-	12	12	-	-	8	-	-	-	4
Anacystis	-	-	-	-	-	-	-	-	-	14	-	-	-
Gleocapsa	-	-	-	-	-	-	28	53	8	20	16	37	53
Gomphospaeria	-	-	-	-	-	-	-	-	-	-	2	-	-
Lyngbya	-	-	-	-	-	6	-	-	-	-	-	-	-
Oscillatoria	12	12	25	25	19	38	24	36	37	16	20	24	4
Total	24	18	25	25	31	56	52	89	53	50	38	61	61
Total Phytoplankton	24	24	25	25	31	75	88	113	104	155	81	101	124
ZOOPLANKTON													
Brachionus (Rotifera)	1265	175	44	144	232	225	315	339	470	582	262	282	302
Copepod Calanoid (Acartia tonsa)	50	63	19	38	19	12	8	8	6	16	2	4	32
Copepod Nauplius (Acartia)	163	3	19	38	75	31	36	28	87	162	158	209	28
Total Zooplankton	1478	241	82	220	326	268	359	375	563	760	422	495	362

Column 1 - 6/4/75
Column 2 - 6/11/75
Column 3 - 6/18/75
Column 4 - 6/25/75
Column 5 - 7/2/75

Column 6 - 7/9/75
Column 7 - 7/16/75
Column 8 - 7/23/75
Column 9 - 7/28/75
Column 10 - 7/30/75

Column 11 - 8/1/75
Column 12 - 8/4/75
Column 13 - 8/12/75

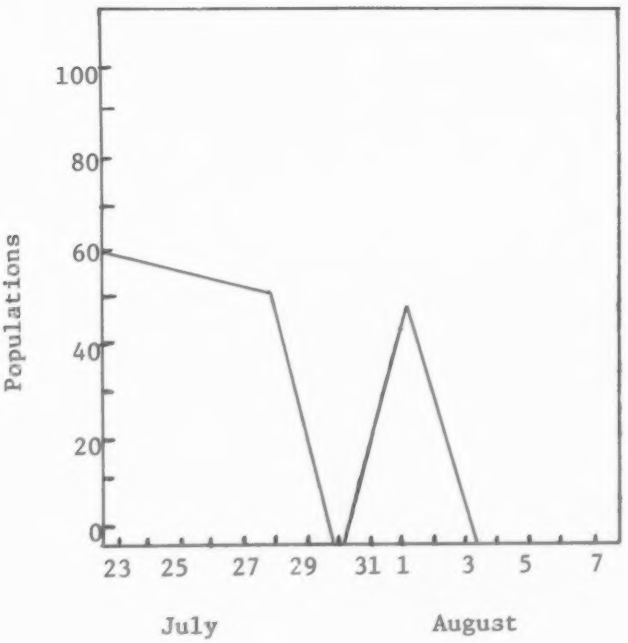
Item 227

Phytoplankton counts (in org/l) obtained from the MSU/NSTL Empire Mix treated pond during pond study 2.

PHYTOPLANKTON	1	2	3	4	5	6	7	8	9	10	11	12	13
Chlorophycophyta													
Closteridium	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysophycophyta													
Amphora	-	-	-	-	-	-	-	-	4	2	6	4	-
Melosira	-	-	-	-	-	-	8	4	14	14	4	-	32
Navicula	-	-	-	-	-	-	4	8	10	24	4	6	6
Nitzschia sp.	-	-	-	-	-	-	4	8	8	38	24	-	2
N. closterium	-	-	-	-	-	-	-	-	-	-	-	-	-
Pleurosigma	-	6	-	-	-	-	-	-	-	2	2	-	-
Total	-	6	-	-	-	-	16	20	36	80	40	10	40
Cyanophycophyta													
Anabaena	31	-	6	-	-	-	-	-	-	20	-	-	-
Anacystis	-	-	-	-	-	-	-	-	-	18	-	-	-
Gleocapsa	-	-	-	-	-	-	16	16	31	6	12	12	31
Gomphospaeria	-	-	-	-	-	-	-	-	-	-	-	-	-
Lyngbya	-	-	-	-	-	-	-	-	-	-	-	-	-
Oscillatoria	12	19	19	6	6	12	8	8	12	14	10	0	10
Total	43	19	25	6	6	12	24	24	43	58	22	12	45
Total Phytoplankton	43	25	25	6	6	12	40	44	79	138	62	22	85
ZOOPLANKTON													
Brachionus (Rotifera)	250	319	75	44	19	269	109	44	4	-	22	69	118
Copepod Calanoid (Acartia tonsa)	106	38	12	118	-	12	8	-	-	-	-	-	-
Copepod Nauplius (Acartia)	188	44	63	31	-	6	24	16	-	-	8	4	10
Total Zooplankton	544	401	150	193	19	287	141	60	4	-	30	73	128

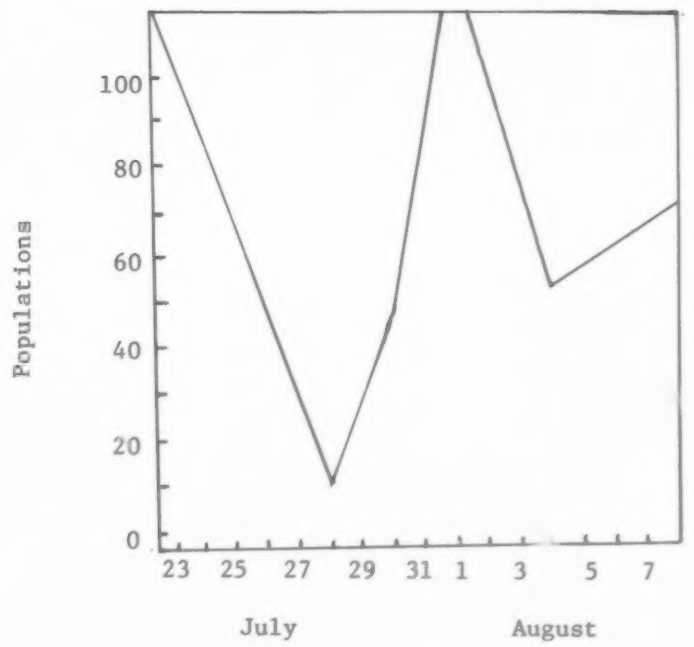
Column 1 - 6/4/75
Column 2 - 6/11/75
Column 3 - 6/18/75
Column 4 - 6/25/75
Column 5 - 7/2/75
Column 6 - 7/9/75
Column 7 - 7/16/75
Column 8 - 7/23/75
Column 9 - 7/28/75
Column 10 - 7/30/75
Column 11 - 8/1/75
Column 12 - 8/4/75
Column 13 - 8/12/75

Item 229



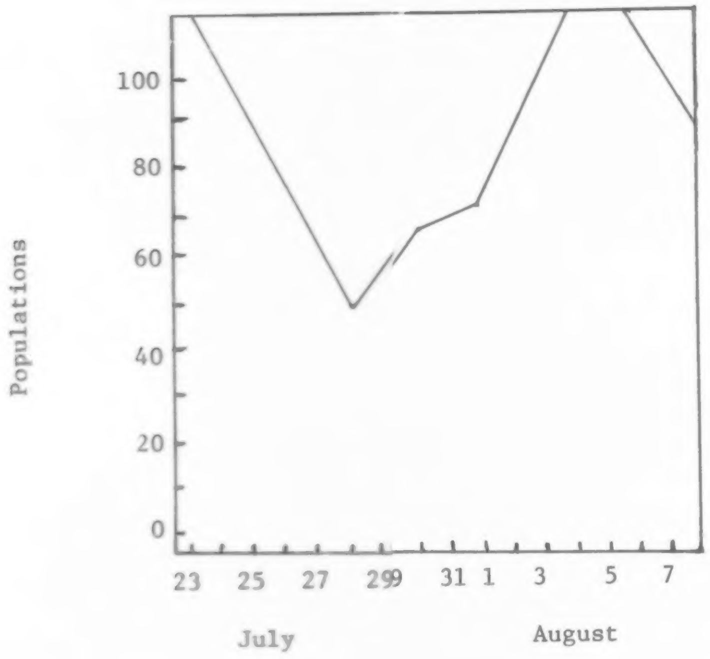
Populations on BBM plates from core camples taken from Pond 2 (July 23 through August 8).

Item 230

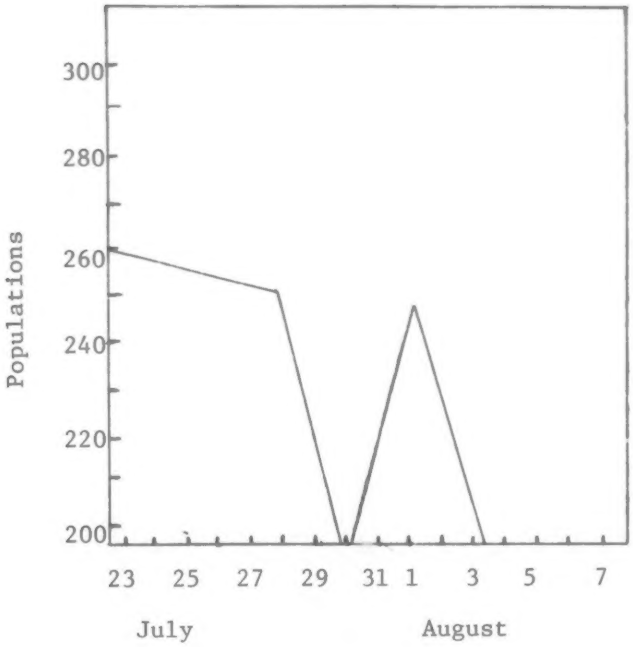


Populations on BBM plates from core samples taken from pond 3 (July 23 through August 8).

Item 231



Populations on BBM plates from core samples taken from pond 4 (July 23 through August 8).



Populations on BBM plates from core samples taken from pond 5 (July 23 through August 8).

Item 233

Microbial counts associated with oyster samples taken following the oil spills in pond study 2.

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml of Oyster Juice	No. of Oysters Tested per Sampling Area	Avg. Amount* of Oil/Sample µg oil/g Oyster Tissue
7/23/75	2	A	3.69×10^4	2	0
		B	8.8×10^4	2	0
		C	3.35×10^4	2	0
		D	1.6×10^5	2	0
	3	A	6.67×10^5	2	0
		B	4.1×10^4	2	0
		C	1.14×10^5	2	0
		D	4.79×10^5	2	0
	4	A	1.7×10^5	2	0
		B	3.8×10^4	2	0
		C	3.1×10^4	2	0
		D	3.23×10^5	2	0
	5	A	3.34×10^5	2	0
		B	4.14×10^5	2	0
		C	2.24×10^5	2	0
		D	8.5×10^4	2	0
8/7/75	2	A	1.34×10^7	10	0
		B	1.31×10^7	10	0
		C	2.76×10^7	10	0
		D	1.04×10^7	10	0
	3	A	6.46×10^6	10	189
		B	7.86×10^6	10	208
		C	1.36×10^7	10	251
		D	6.09×10^6	10	154
	4	A	3.76×10^6	10	27
		B	2.73×10^6	10	63
		C	1.89×10^6	10	103
		D	2.2×10^5	10	78

Item 233 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml of Oyster Juice	No. of Oysters Tested per Sampling Area	Avg. Amount* of Oil/Sample µg oil/g Oyster Tissue
8/7/75 (cont.)	5	A	3.85×10^5	10	77
		B	1.64×10^5	10	22
		C	1.67×10^5	10	68
		D	7.08×10^5	10	54
9/8/75	2	A	1.0×10^5	10	0
		B	9.07×10^4	10	0
		C	1.37×10^5	10	0
		D	3.09×10^4	10	0
	3	A	9.95×10^4	10	20
		B	1.29×10^5	9	14
		C	8.10×10^4	10	22
		D	5.33×10^4	10	16
	4	A	1.23×10^5	10	9
		B	1.82×10^5	9	1
		C	1.56×10^5	9	3
		D	6.37×10^4	10	4
	5	A	5.71×10^5	9	9
		B	1.43×10^5	10	14
		C	5.82×10^4	10	8
		D	1.73×10^5	10	11
9/16/75	2	A	TNTC @ 10^4	10	0
		B	TNTC @ 10^4	10	0
		C	TNTC @ 10^4	10	0
		D	TNTC @ 10^4	10	0
	3	A	TNTC @ 10^4	10	3
		B	TNTC @ 10^4	10	13
		C	TNTC @ 10^4	10	10
		D	TNTC @ 10^4	10	13
	4	A	TNTC @ 10^4	10	9
		B	TNTC @ 10^4	10	2
		C	TNTC @ 10^4	10	5
		D	1.36×10^5	10	19

Item 233 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml of Oyster Juice	No. of Oysters Tested per Sampling Area	Avg. Amount* of Oil/Sample µg oil/g Oyster Tissue
9/16/75 (cont.)	5	A	8.59×10^4	9	11
		B	8.9×10^4	9	13
		C	1.26×10^5	8	27
		D	1.31×10^5	10	31
10/1/75	2	A	1.23×10^6	10	0
		B	4.1×10^6	10	0
		C	6.02×10^6	10	0
		D	1.41×10^7	9	0
	3	A	9.97×10^5	10	20.8
		B	1.35×10^6	10	20.5
		C	2.14×10^6	10	37.2
		D	7.93×10^6	10	16.0
	4	A	5.18×10^6	10	14.5
		B	4.25×10^6	10	8.3
		C	6.42×10^6	10	13.4
		D	7.34×10^6	10	18.8
	5	A	2.43×10^5	10	8.5
		B	3.49×10^5	10	15.4
		C	1.32×10^6	10	9.7
		D	3.22×10^5	10	26.4
10/11/75	2	A	1.95×10^5	5	0
		B	3.50×10^5	5	0
		C	3.07×10^5	5	0
		D	4.01×10^5	5	0
	3	A	2.43×10^5	5	11.8
		B	9.17×10^5	5	51.2
		C	4.54×10^5	5	5.2
		D	1.55×10^5	5	11.0
	4	A	2.21×10^5	5	3.4
		B	1.75×10^5	5	16.6
		C	1.76×10^5	5	8.5
		D	1.3×10^5	5	12.3

Item 233 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml of Oyster Juice	No. of Oysters Tested per Sampling Area	Avg. Amount* of Oil/Sample µg oil/g Oyster Tissue
10/11/75 (cont.)	5	A	1.63×10^5	5	4.8
		B	6.67×10^4	5	15.0
		C	5.33×10^4	5	11.2
		D	2.93×10^5	5	6.0
4/19/76	2	A	-	8	0
		B	-	8	0
		C	-	8	0
		D	-	8	0
	3	A	-	7	16
		B	-	9	14
		C	-	10	0
		D	-	8	0
	4	A	-	4	2
		B	-	3	0
		C	-	6	0
		D	-	7	5
	5	A	-	9	6
		B	-	6	0
		C	-	3	0
		D	-	7	0

*The average concentration of the aromatic hydrocarbons present in control oysters was subtracted out of the values determined for treated oysters.

Item 234

Microbial counts associated with mud samples taken after the oil spills in pond study 2.

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/g in Sampling Area	Avg. Amount* of oil in Sample (μg/g)
7/23/75	2	SE(A)	6.0×10^5	0.1
		NE(B)	1.6×10^5	
		NW(C)	7.0×10^4	
		SW(D)	1.0×10^5	
	3	SE(A)	3.0×10^5	0.7
		NE(B)	5.5×10^5	
		NW(C)	2.6×10^5	
		SW(D)	1.8×10^5	
	4	SE(A)	7.0×10^4	0.5
		NE(B)	9.0×10^4	
		NW(C)	1.4×10^5	
		SW(D)	1.5×10^5	
	5	SE(A)	2.2×10^5	0.3
		NE(B)	1.9×10^5	
		NW(C)	1.6×10^5	
		SW(D)	1.3×10^5	
7/31/75	2	EAST	1.3×10^5	1.0
		WEST	4.9×10^5	1.6
	3	EAST	1.4×10^6	32.8
		WEST	9.5×10^5	1.9
	4	EAST	2.3×10^5	0.9
		WEST	3.0×10^5	0.3
	5	EAST	1.5×10^5	5.8
		WEST	4.0×10^5	30.8
8/7/75	2	NORTH	1.13×10^5	1.7
		SOUTH	5.7×10^4	6.9

Item 234 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/g in Sampling Area	Avg. Amount* of oil in Sample (µg/g)
8/7/75	3	NORTH	3.7×10^5	3.6
(cont.)		SOUTH	1.02×10^6	3.6
	4	NORTH	2.8×10^5	1.1
		SOUTH	3.93×10^5	1.2
	5	NORTH	2.63×10^5	2.9
		SOUTH	1.73×10^5	28.2
9/8/75	2	EAST	6.0×10^5	
		WEST	2.5×10^5	
	3	EAST	5.27×10^5	
		WEST	1.17×10^6	
	4	EAST	2.4×10^5	
		WEST	4.83×10^5	
	5	EAST	9.6×10^4	
		WEST	7.3×10^4	
9/10/75	2		2.67×10^4	1.3
	3		1.47×10^6	1.1
	4		2.13×10^5	0.9
	5		1.67×10^5	2.4
9/16/75	2		1.73×10^5	1.1
	3		7.2×10^5	0.6
	4		1.63×10^5	0.6

Item 234 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/g in Sampling Area	Avg. Amount* of oil in Sample (μg/g)
9/16/75	5		4.5×10^4	0.8
4/19/76	2	2N	2.06×10^6	1.5
		2N1	3.63×10^6	6.8
		2S	2.77×10^6	1.4
		2S1	1.15×10^6	12.9
		2E	3.16×10^6	0.5
		2E1	3.25×10^6	1.7
		2W	2.87×10^6	2.2
		2W1	3.38×10^6	1.9
		2C	1.81×10^6	0.9
		2C1	2.21×10^6	1.7
	3	3N	2.96×10^6	6.4
		3N1	2.36×10^6	15.5
		3S	1.5×10^6	17.5
		3S1	1.51×10^6	4.5
		3E	2.18×10^6	16.0
		3E1	1.12×10^6	13.7
		3W	1.70×10^6	0.8
		3W1	2.32×10^6	19.5
		3C	6.87×10^5	19.8
		3C1	9.7×10^5	16.1
	4	4N	2.2×10^5	0.4
		4N1	1.5×10^5	0.3
		4S	1.13×10^6	0.2
		4S1	1.32×10^6	1.2
		4E	1.27×10^6	0.7
		4E1	1.61×10^6	7.5
		4W	8.13×10^5	7.7
		4W1	9.83×10^5	0.1
		4C	1.62×10^6	0.3
		4C1	1.98×10^6	0.8

Item 234 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/g in Sampling Area	Avg. Amount* of oil in Sample (μg/g)
	5	5N	1.94×10^6	1.0
		5N1	4.85×10^6	0.6
		5S	4.87×10^6	0.6
		5S1	3.68×10^6	10.7
		5E	1.81×10^6	12.0
		5E1	1.77×10^6	0.5
		5W	2.35×10^6	1.2
		5W1	1.76×10^6	1.1
		5C	5.23×10^5	0.2
		5C1	9.3×10^5	0.2

*These values reflect the total aromatic hydrocarbons present in the samples (oil + biogenic). Oil concentrations given for the control ponds were calculated based on Empire Mix. Oil concentrations given for the other ponds were calculated based on the oil spilled on each pond.

Item 235

Microbial counts associated with water samples taken after the oil spills in pond study 2.

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml in Sampling Area	Amount* of oil in Sample (μg/1)
7/23/75	2	A	2.0×10^3	85
		B	2.2×10^3	
		C	3.7×10^3	
		D	3.6×10^3	
	3	A	3.4×10^3	14
		B	2.4×10^3	
		C	3.5×10^3	
		D	2.4×10^3	
	4	A	3.6×10^3	266
		B	3.3×10^3	
		C	2.5×10^3	
		D	2.7×10^3	
	5	A	5.0×10^2	590
		B	6.0×10^2	
		C	4.0×10^2	
		D	1.0×10^3	
	2	EAST	7.7×10^2	1017
		WEST	1.4×10^3	831
	3	EAST	2.7×10^3	335
		WEST	1.7×10^3	511
	4	EAST	3.3×10^3	149
		WEST	5.0×10^3	223
	5	EAST	6.0×10^2	78
		WEST	5.0×10^2	254

Item 235 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml in Sampling Area	Amount* of oil in Sample (μg/1)
7/27/75	2	EAST	7.0×10^2	215
		WEST	1.0×10^3	142
	3	EAST	1.0×10^3	28
		WEST	1.1×10^3	107
	4	EAST	1.9×10^3	24
		WEST	2.1×10^3	111
	5	EAST	5.0×10^2	216
		WEST	5.0×10^2	58
7/28/75	2	EAST/WEST	1.0×10^3	31
	3	EAST/WEST	4.5×10^3	190
	4	EAST/WEST	3.5×10^3	33
	5	EAST/WEST	4.0×10^2	120
7/30/75	2	EAST	8.0×10^2	49
		WEST	8.0×10^2	93
	3	EAST	6.1×10^3	49
		WEST	4.8×10^3	94
	4	EAST	1.6×10^3	19
		WEST	1.4×10^3	24
	5	EAST	8.0×10^2	51
		WEST	6.0×10^2	33
7/31/75	2	EAST	2.2×10^3	39
		WEST	2.4×10^3	28
	3	EAST	7.6×10^3	15
		WEST	6.8×10^3	120

Item 235 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml in Sampling Area	Amount* of oil in Sample (μg/1)
	4	EAST	2.3×10^3	32
		WEST	2.7×10^3	21
	5	EAST	7.0×10^2	28
		WEST	7.0×10^2	18
8/1/75	2	EAST	2.9×10^3	24
		WEST	3.8×10^3	17
	3	EAST	6.4×10^3	293
		WEST	5.8×10^3	133
	4	EAST	3.8×10^3	302
		WEST	3.5×10^3	85
	5	EAST	8.0×10^2	564
		WEST	1.4×10^3	64
8/7/75	2	EAST & WEST	-	395
		TOP	2.0×10^2	
		BOTTOM	2.0×10^2	
	3	EAST & WEST	-	68
		TOP	1.46×10^4	
		BOTTOM	3.13×10^3	
	4	EAST & WEST	-	51
		TOP	5.7×10^2	
		BOTTOM	2.7×10^3	
	5	EAST & WEST	-	364
		TOP	1.25×10^3	
		BOTTOM	3.7×10^2	

Item 235 (cont.)

Date of Sample	Pond #	Area of Pond Sampled	Avg. No. of Bacteria/ml in Sampling Area	Amount* of oil in Sample (μg/1)
9/10/75	2	-	-	120
	3	-	-	166
	4	-	-	258
	5	-	-	448
9/16/75	2	-	-	48
	3	-	-	73
	4	-	-	22
	5	-	-	113
10/1/75	2	-	-	
	3	-	-	
	4	-	-	
	5	-	-	

*These values reflect the total aromatic hydrocarbons present in the samples (oil + biogenic). Oil concentrations given for the control pond were calculated based on Empire Mix. Oil concentrations given for the other ponds were calculated based on the oil spilled on each pond.

Item 236

Tests of microbiological types in oysters, mud and water samples following the oil spills in pond study 2.

From Sample 7/23/75

Sample #	Growth	Est. of Colonial Types	Hemolysis
Oysters			
4A1	H	3-4	H
4B1	L	2-3	-
4C1	M	4-5	M
4D1	L	2	-
5A1	M	3-4	M
5B1	H	4-5	M
2A1	L	2	-
2B1	L	2	-
3A1	L	2	-
3B1	L	2	-
2C1	L	1	-
2D1	M	2-3	H
3C1	M	3-4	M-H
3D1	M	2-3	M-H
5C1	M	4-5-6	H
5D1	M	4-5	H

Item 236 (Cont.)

Sample #	Growth	Est. Types	Hemolysis
Water			
5A	L	1	-
5C	-	-	-
4A	-	-	-
4C	L	3	-
3A	L	2	-
3C	L	1	-
2A	L	2-3	-
2C	L	1-2	-
Mud			
3A	M	4-5	1 large zone
3B	M	4-5	1 large zone
4A	L	3-4	Double zone
4B	L	3-4	-
5A	L	2-3	-
5B	L	2	-
2A	L	3	1 large zone
2B	L	4	1 large zone
2C	M	4-5	2 zones
2D	L	3-4	-
3C	L	3-4	M 1 large zone
3D	L	3-4	1 large zone
4C	L	3-4	-
4D	L	2-3	-
5C	L	1	-
5D	L	1	-

Item 237

Radiocarbon uptake (mg l^{-1} hr^{-1}) by natural phytoplankton community in Ecosystem Research Ponds before and after simulated low level oil spills.

Treatment/dates	Replicates Re	Ponds			
		2	3	4	5
		Control	NCO	SAC	EMC
Pre-spill 7/21/75	1	0.572	0.945	0.593	0.353
	2	0.536	0.986	0.754	0.375
	3	0.555	0.943	0.829	0.463
	Mean	0.554	0.958	0.725	0.397
Pre-spill 7/24/75	1	0.773	1.226	1.203	1.051
	2	0.776	0.995	1.006	0.995
	Mean	0.775	1.111	1.105	1.003
Post-spill 7/31/75	1	1.653	1.243	1.024	1.429
	2	1.474	1.494	1.358	1.443
	3	1.657	1.283	1.148	1.393
	4	1.450	1.262	1.276	1.429
	Mean	1.559	1.321	1.202	1.424
8/29/75	1	0.647	1.403	2.029	0.670
	2	0.955	1.433	2.083	0.636
	3	0.798	1.283	1.973	0.752
	4	0.685	1.411	1.954	0.677
	5	0.963	1.418	1.960	0.656
	6	0.741	1.251	1.978	0.693
	Mean	0.798	1.367	1.996	0.681
9/19/75	1	1.091	5.207	2.694	1.551
	2	1.221	5.280	2.362	1.344
	3	1.128	4.624	2.777	1.340
	4	1.131	5.288	2.624	1.494
	5	1.217	5.431	2.473	1.336
	6	1.162	4.703	2.726	1.400
	Mean	1.158	5.089	2.609	1.411
10/3/75	1	1.072	5.016	1.656	1.191
	2	1.068	4.172	1.831	1.171
	3	1.063	4.218	1.597	1.110
	4	0.995	4.937	1.615	1.197
	5	0.997	4.176	1.779	1.179
	6	1.077	4.761	1.558	1.057
	Mean	1.022	4.463	1.673	1.151

Treatment/dates	Replicates	Ponds			
		2	3	4	5
		Control	NCO	SAC	EMC
11/21/75	1	1.605	3.997	1.469	0.674
	2	1.823	5.222	1.510	0.718
	3	1.855	4.531	1.448	0.594
	4	1.564	4.205	1.470	0.690
	5	1.875	5.154	1.550	0.698
	6	1.915	4.787	1.427	0.592
	Mean	1.781	4.469	1.479	0.661
12/1/75;	1	0.032	2.623	1.373	3.072
	2	0.881	3.326	1.353	3.186
	3	1.039	2.066	1.294	2.946
	4	0.911	2.530	1.251	3.049
	5	----	3.257	1.372	3.143
	6	----	2.066	1.346	2.896
	Mean	0.966	2.645	1.332	3.049

Item 238

Effect of Empire Mix crude oil on radiocarbon uptake of natural phytoplankton community. Environmental conditions during the two experiments were pH=7.5, Alk.=32 and Temp.= 25°C for 8/11/75 and pH=7.0, Alk.=30 and Temp.= 26°C for 8/18/75.

Treatment	Replicates	Radiocarbon uptake (mg/l/hr)	
		Expt. 1 (8/11/75)	Expt. 2 (8/18/75)
Control	1	0.020	4.006
	2	2.110	3.262
	3	1.883	3.574
	4	1.986	4.047
	5	2.076	3.210
	6	1.836	3.380
	Mean	1.985	3.580
Oil 10 ppm	1		2.341
	2		2.304
	3		2.231
	4		2.381
	5		2.254
	6		2.260
	Mean		2.250
Oil 100 ppm	1	0.187	0.341
	2	0.163	0.419
	3	0.153	0.407
	4	0.184	0.335
	5	0.164	0.433
	6	0.174	0.399
	Mean	0.171	0.396

Item 239

Total pigment (µg/l) concentration of phytoplankton community in the Ecosystem Research Pond before and after simulated low level oil spills.

Treatment/dates	Replicates	Ponds			
		2	3	4	5
			NC	SAC	EMC
Prespill 7/21/75	1	1.348	4.045	2.697	-----
	2	-----	2.697	2.247	1.124
	3	1.798	6.742	3.146	1.798
	Mean	1.573	4.495	2.697	1.461
Prespill 7/24/75	1	1.724	3.281	3.281	1.225
	2	1.618	2.764	2.584	1.964
	3	1.618	2.764	2.584	1.154
	Mean	1.653	2.936	2.816	1.448
Post Spill 7/31/75	1	3.101	2.247	1.393	1.730
	2	2.944	2.247	2.067	1.910
	3	2.944	1.730	2.944	2.584
	Mean	2.966	2.075	2.135	2.705
8/29/75	1	1.214	1.910	6.562	1.551
	2	1.034	2.247	6.921	1.214
	3	0.854	2.764	6.045	1.551
	Mean	1.034	2.307	6.509	1.439
9/19/75	1	1.037	8.470	6.742	3.111
	2	1.383	9.507	6.742	3.803
	3	1.383	8.989	7.260	3.803
	Mean	1.268	8.989	6.897	3.572
10/3/75	1	0.086	10.026	5.186	2.074
	2	0.173	10.717	5.528	1.729
	3	0.346	10.545	6.914	1.556
	Mean	0.202	10.429	5.876	1.786
11/21/75	1	1.124	9.888	5.393	1.124
	2	1.384	12.135	5.843	1.124
	3	1.789	11.658	5.843	0.899
	Mean	1.049	11.227	5.726	1.049
12/1/75	1	----	7.640	4.045	1.348
	2	1.034	8.090	3.596	1.348
	3	1.034	8.090	2.697	1.348
	Mean	1.034	7.940	3.446	1.348

Item 240

Oil residue in marsh plants collected from the MSU/NSTL Ecosystem Research Ponds after 5 days after second spillage of oils on July 25, 1975.

					Total Oil	
Treatment	Pond No.	Plants			LC µg/g	GC
Control	2	Juncus				
			Top	Alive	0	
				Dead	0	
			Bottom	Alive	0	
				Dead	0	
		Scirpus				
			Top	Alive	0	
			Bottom	Alive	0	
Saudi Arabian Oil	3	Juncus				
			Top	Alive	0	
				Dead	31	
			Bottom	Alive	156	
				Dead	109	
		Scirpus				
			Top	Alive	0	
			Bottom	Alive	48	
Nigerian Oil	4	Juncus				
			Top	Alive	0	
				Dead	11	
			Bottom	Alive	13	
				Dead	24	
		Scirpus				
			Top	Alive	0	
			Bottom	Alive	0	
Empire Mix Oil	5	Juncus				
			Top	Alive	1	
				Dead	306	
			Bottom	Alive	231	
				Dead	1080	
		Scirpus				
			Top	Alive	0	
			Bottom	Alive	44	